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Jesse Lake, Nebraska, showing pump-house and pipe line used to move the potash-bearing brine to the railroad

Potash from Sand-Hill Lakes

By R. P. Crawford

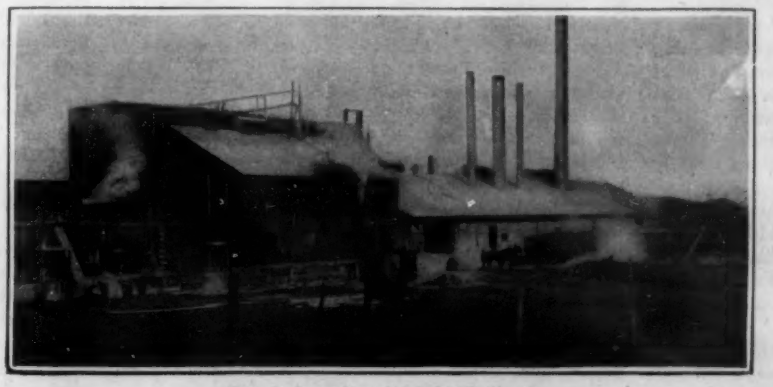
WHEN the war clouds began to gather two and a half years ago, Americans found the available supply of German potash rapidly diminishing, and a satisfactory source was eagerly sought in this country. Kelp, alunite and orthoclase became common to the vocabulary of those engaged in the potash chase, and numerous mineral deposits which gave promise of value were exploited in the daily press. In many cases, however, there appeared to be more talk and experiment than actual accomplishment, although, as our readers know, the dream of potash from kelp is now being realized on the Pacific coast.

While the potash search was on, Nebraskans alone could take the shortage philosophically. Almost before the first year of the war was over Nebraska scientists and business men had solved at least one phase of the potash shortage and opened up a new source of the much sought for product. The brackish lakes in the northwestern part of the State, it was ascertained, held quantities of valuable salts, a fact which was hitherto not generally known. Those engaged in the enterprise worked quietly and it was some months before the people of the State realized that Nebraska suddenly had become one of the greatest, if not the greatest, potash producing State in the union.

At least three companies to-day are engaged in the potash business in northwestern Nebraska and one of them, the pioneer in the field, apparently is meeting with signal success. As if by magic, a tiny potash town, Hoffland by name, has sprung up 12 miles east of Alliance in that State. It now boasts of a population of about three hundred and the concern engaged in the pioneer work at that point has about one hundred men on its payroll. Another town, Antioch, a few miles farther to the east, has joined in the potash excitement and two companies are now busy in its midst, prospecting and carrying out their unique mining operations. It has been reported that American packing companies which need potash in the manufacture of soap have interested themselves in some of the lakes.

Geologists often have pointed to the sand-hill lakes as being of possible value in a commercial way. Practically all of the sand-hill district in northwestern Nebraska is dotted with these ponds and brackish lakes, many of which dry up in the summer, leaving a salty residue around their banks. Some little work is reported to have been done years ago in removing alkali from these waters, attempts being made in the dry season to scoop up the salts around the shores, pack the product in bags and ship it to eastern markets. Naturally such a plan as this was out of the question if a commercial success was to be made of the business. Constant experiments meanwhile were made by those interested in the development of the lakes but it was necessary to wait for the great war to make the recovery of potash from that source financially interesting.

When it was seen that the supply from the great potash beds of Prussia was cut off, a group of Nebraska business men and scientists joined forces and set out to discover a plan to extract the precious salts from the alkali lakes. The pioneer company on the scene chose Jesse Lake,



The evaporating plant at Hoffland

covering about two hundred and fifty acres near what was to be the town of Hoffland. This particular lake was chosen because analyses showed that its waters contained a larger percentage of potash salts than the other lakes and naturally potash rather than soda salts were of first consideration.

But here was an engineering problem indeed. The potash was in the lake, along the shores, and in a great layer of salty, sandy brine 20 feet below the surface water and its underlying layer of hardpan. How were the salts to be extracted from the brackish waters?

That problem alone might well have perplexed men of great engineering skill, but in addition the lake was three miles from a railroad and across sand hills of no small size. Power for carrying out the processes would have to be available and a way would have to be found to get the product to the railroad. To haul fuel to a plant by wagon and then cart the product across the sand hills to a railroad would have been an arduous undertaking, while the building of a railroad spur in that country would have been a costly experiment if it had turned out that the extraction of salts from the lake was not to be a success after all.

Here were the two problems and it must be remembered that both of them had to be solved in a way to make the undertaking commercially profitable. The men in charge were of an inventive turn of mind and so they decided to pump the brine out from under the lake bed, boil it down and carry the process until the salts finally crystallized out. To get the product to the railroad—that would be simple indeed. The evaporating plant would be located on the railroad, with a three-mile pipe line to bring the raw brine to it from the pump-house at the lake. There would then be no trouble about hauling coal to the evaporating plant and no trouble in getting the salts to a shipping point.

It was carried out as planned. Pumps were placed in a house erected on piles out in the lake and the pipe line was led over and under the sandhills to an evaporating plant on the railroad.

In order to understand how the pumping was done one must remember the nature of the lake. The top water in Jesse Lake is not more than two or three feet deep most of the time. Underneath this surface water is a layer of hardpan. Then there is a layer of eight to twelve feet of sandy brine. There is another layer of hardpan and then fresh water. No attention was paid to the surface water or to the deposits of salts around the shore. A pump extending about twenty feet down into the lake bed easily pierced the upper hardpan and reached the layer of sandy brine. When this had been done the electric pump—securing its current from the main plant—was put at work and the briny water flowed over and under the sandhills to the evaporating plant three miles distant. Filters of course were used to prevent the sand from being sucked up along with the brine. After a short time the operations were extended and two pipe lines were in operation, the two and a half inch line being supplemented by one of four inches. The pipe lines are laid in a trench for protection against zero weather and the pumping can be carried on throughout the winter.

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

If the United States Should Go To War

IF we are drawn into the world war, we may well prove to be the decisive factor; even though we land not a single soldier upon European soil. For it is a fact, well understood by the statesmen and strategists of Europe, that if we were lined up with the Allied cause we should place it in an impregnable position in respect of two of the most vital necessities for the winning of a war of this magnitude, namely, financial resources and munitionment.

Excellent though it may be in morale and in its all-round military efficiency, our army would be lost amid the embattled millions of Europe; and the fact that Great Britain defeated the German fleet off Jutland, and drove it back into its harbors and now holds it there, proves that our battleships would be superfluous in the North Sea. But the moment our enormous financial resources and our vast potentiality for the manufacture of guns, powder and shells, were lined up behind the allied armies, the ultimate overthrow of the Central Powers would be as certain as the rise and setting of the sun.

If we went into the war, it should be our policy to apply our strength where it would bring the most immediate and decisive results. Outside of certain defensive measures against submarine attack in our home waters, we should bring our potential strength to bear on that part of the European battlefield where it is most needed and would have the greatest effect. Such a field is to be found on the Russian front.

Russia has, to-day, with the colors, nearly ten million men. Of these about five million are fairly well armed, equipped and munitioned. If the whole of that mighty army were munitioned on the scale of the Central Powers, it would roll, like a tidal wave, across the plains of Poland and Galicia, and might well engulf Berlin itself. We have only to bear in mind how Brusiloff, last summer, swallowed up the Austrian armies, and ceased his onward rush only when his winter's accumulation of munitions was depleted.

Enormous though the task would be of munitioning those 5,000,000 men, now undergoing constant training at the depots, so vast are our resources that we could do it, and do it at a rate greater even than that at which Great Britain munitioned her own armies. For our resources in the way of steel mills and machine shops, iron ore, coal, coke and the necessary labor must be fully double those of Great Britain.

Already we are hearing too much about home defense. The best defense of the United States would be a strong offensive against the enemy on the battlefields of Europe; and the best offensive we could wage in Europe would be to provide that reserve army of 5,000,000 men with the full equipment for continuous service at the front.

Next to the munitionment of the Allies, our efforts should be directed to the smothering of the brutal submarine campaign against merchant shipping. If Great Britain should be starved into surrender, there would be nothing between us and the German fleet but our own fleet of just half its strength—and back of a victorious German fleet would be the German fleet of transports and the millions of the veteran German army. The most effective weapon against the submarine, when it is operating as it is to-day in deep water, is the submarine chaser, a 30-knot, 100-foot, sea-going craft, carrying a powerful rapid-fire gun on its fore deck. We should lay down at least a thousand of these, and send them to assist in keeping open the lanes of approach for our grain and supply ships to the allied coasts.

For home defense against such submarines and raiders as might escape to our coasts, our own cruisers, destroyers and motor-boat flotillas would be sufficient. This would release the allied cruisers for convoy service and work in the Channel, the North Sea and the Mediterranean.

Also, as we said last week, it is imperative that we at once net the entrances to our harbors and roadsteads and the approaches to the Panama Canal, and maintain a thorough search for German submarine bases on the Mexican coast and in the islands of the Caribbean Sea.

Above all, Congress should leave the determination of all naval and military measures to the General Staff and the General Board of the Navy. Else, we are in for a series of military blunders and the expenditure of monies and waste of time and effort in enterprises which will be utterly fruitless.

Already there is a move in Congress to build 100 submarines. Of what use would they be? Submarines cannot fight submarines. Again, we note that there is a proposal to provide a large number of anti-aircraft guns. What for? Where are the aircraft to come from—or the airships?

If we should, unhappily, be forced into this war, let us direct our strength, as we have suggested above, where it can strike most swiftly, in the greatest magnitude, and with most decisive effect.

A Fatal Defect In Our Battle-Cruiser Designs

IN an illustrated article on the new battle-cruisers, which we published on December 16, 1916, there occurs the following sentence; "We shall see in these ships the novelty of the boiler-and-engine plant being located upon two decks." Having in mind the fact that it was a cardinal principle of warship design to place the whole of the main motive power below the protective deck, and therefore below the water-line. we were puzzled at the time to understand how sufficient vertical height could be found to accommodate two tiers of boilers upon two decks below the protective deck; but we concluded that the Bureaus of Steam Engineering and of Construction and Repair had found some way to do this. At the time of the opening of the bids, however, we learned, to our profound amazement, that one-half of the boiler plant was to be placed *above the water-line, where it would be exposed to destruction by the 11, 12 and 15-inch shells, with which alone modern engagements between capital ships are fought.*

A study of the wash drawing of these ships, prepared by the Navy Department for the press of the country, shows, it is true, that there is a belt of side armor in the wake of the deck upon which these boilers have been placed; but it takes only an elementary knowledge of warship design to make it evident that in a ship of only 35,000 tons displacement, after provision has been made for the enormous weights involved in a motive power plant of 180,000 horse-power and for a battery of ten 50-caliber 14-inch guns with their heavy barbettes and turrets, there cannot be very much displacement left for side armor; and if it has been possible to carry a belt of say four to six-inch armor throughout some five hundred feet of the length of these ships, the designers have done very well indeed.

Now it has been well established in the present war that any such light armor as this, when opposed to shells of 11 to 15-inch caliber, serves no better purpose than to act as a shell-burster. In the battle of Jutland the 7 and 9-inch armor of the British battle-cruisers was impotent against the 11 and 12-inch shells of the Germans, and three ships were sunk by gun-fire. Calibers are constantly increasing, and our new battle-cruisers, should they ever be lined up for a fight, would be the target for shells of 15, 16 and even 18-inch caliber. Against such projectiles their necessarily light armor would be as impotent as the mere shell plating of the ship itself. Indeed, we have it on direct and highly reliable authority that the British have just completed a class of battle-cruisers in which they have discarded side armor altogether, realizing that it is better to let the shells pass clear through the ship than make sure of their detonating as they pass through light armor that is insufficient to stop them.

Basing our conviction on what has been said above, we feel justified in our belief that the placing of one-half of the boiler plant of these great ships above the water-line exposes it to the risk of being put entirely out of commission by the first successful salvo of the enemy.

Throughout the fifty years of the development of steel warships construction it has been a fundamental principle, which we believe has never until now been violated, that the vitals of the ship (engines, boilers, magazines and steering gear) should be placed below the water-line. Water affords better protection than the thickest armor; for the shells that strike the water before they reach the ship are deflected upwards, and either pass over her altogether or enter the ship above the water-line.

If this grave defect in the battle-cruisers were irremediable, we would say let the designs go through, let the ships run the risk of losing half their boiler power and six or seven knots of their speed. But the defect is not irremediable; for it is well. known, both to the Bureau of Steam Engineering of our Navy and to the engineers of our great shipbuilding companies that, by the substitution of the geared drive for the electric-drive, it is possible to develop the 180,000 horse-power required without placing a single one of the twenty-four boilers, or any part of the engines, above the protective deck.

The Navy Department experts are committed to the electric drive. They wish to employ it, even at the risk of having half the motive power of the ship put out of commission early in an engagement. The private shipbuilders, on the other hand, believe that the geared drive, which is being used on every one of the great fleet of battleships and battle-cruisers which the British have built since the beginning of the war, will give better service in operation, with the added advantages that the power plant will be safe against shell-fire, and that there will be a saving on each ship of 1,000 tons of weight, and a saving in cost on the six battle-cruisers of $7,500,000.

In view of the existing dilemma, and of the fact that upon the behavior of these great ships may depend some day the issues of victory or defeat for the United States Navy, we respectfully suggest to the Secretary of the Navy that he submit this question to the Naval Consulting Board or to an independent Board of Naval Architects and Naval Engineers selected by the Naval Consulting Board. In doing so he will be backed up by precedents, such as the case of the decision as to whether the United States should build a canal at Nicaragua or Panama, and again on the question of whether that canal should be high-level or sea-level. The two Panama Canal Boards passed on an expenditure of $400,000,000; and a like sum of $400,000,000 is involved in the sixteen capital ships of the three-year program that are affected by this question of electric versus geared drive.

But, above all, there may be involved in this matter the fate of the Nation.

Science and Our Industries

DESPITE all the misery and suffering it has caused, we have this war to thank for forcing upon the world a widespread interest in and appreciation of the value of science. Nations which have looked upon science as of little utilitarian value, have been forced to change their attitude. The world over, men are seeking the aid of science to develop natural resources and to improve processes of manufacture. There is danger, however, that in looking upon the commercial side of research work we be apt to overlook the benefits that may accrue from the pursuit of pure science research.

For centuries before the dawn of the present era men were engaged in a purely utilitarian pursuit of chemical research. Two will-o-the-wisps lead them on: the transmutation of baser metals into gold, and the elixir of life which would give man eternal youth. While these were the goals, chemical progress was at a standstill. Then came Boyle, who determined to pursue chemical research with no utilitarian object in view, but merely to add to the world's store of knowledge. From that date, side by side with pure research, there has been a steady progress in applied chemistry.

There is no reason why this country should not be a leader in applied science, but we must not forget that applied science still walks hand in hand with pure science.

On another page we describe the work of the Mellon Institute of Industrial Research and call attention to the department of pure chemical research recently established there. Although this department is intended merely to investigate chemical problems from an academic point of view, it has already been productive of important results that have proved invaluable in the industrial researches of the Institute.

A number of our large manufacturing concerns are equipped with large research laboratories where their products and processes may be investigated and raised to a high degree of efficiency by scientific exploration. Since the war began these laboratories have been called upon to deal with problems that seemingly have no relation to the work with which the owners of the laboratory are concerned, and yet the ramifications of science are so intertwined that it pays to engage in such apparently extraneous investigations.

Recently a visitor to the laboratories of a large electrical company was astonished to find that not only did the work of the laboratory cover widely divergent fields of chemical exploration, but that there was a great deal of pure chemical research done there. There was even a department devoted to mathematical research. Naturally he was astonished to find an industrial institution appreciating the value of such abstract work. Later upon meeting the vice-president of the company he was informed by that individual that the experience of the company had proved the commercial value of pure science research. The laboratory, he stated, was indispensable to the success and progress of the company. It had proved their best paying investment and although certain lines of research had at first been questioned, the company had come to rely absolutely upon the judgment of the director even when he asked for investigation of subjects that appeared to have not the remotest connection with their work. It has all paid in dollars and cents.

Aeronautical Notes

Narrow Escapes of the Kaiser.—Every time the Kaiser visits the battlefronts he is in danger of losing his life; for it is reported that twice recently bombs from the air have narrowly missed the German monarch. A message from Zurich states that a train in which he was traveling was struck by an aerial bomb and the locomotive engineer killed. The Berne correspondent of the *Corriere d'Italia* reports that a house in which the Kaiser slept during his recent visit to the Western front was hit by a bomb from a French aeroplane a few minutes after the Kaiser, the Crown Prince and the staff had left. As it was, the uniforms and other personal effects of the Kaiser were destroyed, together with a number of important documents. The correspondent adds that several servants were killed.

Allied Airmen in Roumania.—Aside from a preponderance of heavy artillery, the remarkable success of the German forces in Roumania appears to have been due to a superior air fleet. Fully cognizant of this condition the British and French governments have sent a large number of aviators, observers, mechanics and other personnel, together with their equipment, to the aid of the Roumanians. The first batch of these machines were piloted from Salonica and the Island of Tenedos, passing over Bulgarian territory, to the Roumanian capital. As early as the beginning of November last, it was reported that 128 French aeroplanes had arrived in Roumania, together with about a dozen British machines. Doubtless this number has been materially increased since then.

An Aeroplane with Rotating Disk Wings.—In a paper recently read before the Institute of Civil Engineers of France, A. Brancher told of his experiments with a model aeroplane of interesting design. While in general appearance the aeroplane follows conventional practice, it differs in that its propelling and sustaining mechanism consists of a number of disks shaped like the blades of certain fans that rotate rapidly in opposite directions on two vertical shafts. It is reported that experiments have been conducted with an electric motor which gave a speed of from 1,000 to 1,500 r. p. m. to the propeller disks. Upon the attaining of the desired speed of revolution the model was released. It maintained a steady forward and ascentional velocity, and preserved its direction and stability. The model is said to correspond to a full sized machine of 10 meters and a weight of 470 kilograms. According to M. Brancher such a machine would preserve its stability under all circumstances, chiefly because of the gyroscopic action of the rotating planes.

Aircraft Coöperation on the Verdun Front.—Writing recently of his experiences on the Verdun front during the last big "drive," a correspondent of the *Daily Telegraph* has the following remarks to make concerning the work of the French aviation corps: "Heavy purple clouds filled the sky, but only a few scurries of rain and sleet fell during the day, and the dark hillsides rising toward the central crest of Douaumont remained clear of mist. This was an important advantage, for the French aviators were able to carry on without cessation their valuable work. Despite a strong and icy wind the great biplanes and the little Nieuports came and went, while a dozen sausages held permanent guard at the end of their long cables. There must have been some German planes near the front, but I did not see one on our side of the lines, and I saw one German observation balloon, and that was falling like a huge torch beyond Douaumont, an incident typical of the enemy's day. Everywhere the sky is splashed with the rising and falling flames of signal rockets, and in every part of the front intrepid airmen swim in and out of the zone of death."

Forecasting Weather from an Aeroplane.—At the annual meeting in Edinburgh on December 13th of the Scottish Aeronautical Society, a paper on "Weather Observation from an Aeroplane," by Lieut. C. K. M. Douglas, R.F.C., was read. Having been fortunate enough to be for some months this year almost daily amongst the clouds of Northern France, Lieut. Douglas has studied the formation of both stratus and cumulus clouds at close quarters, and submitted some records of the temperature and other conditions under which they developed. A cumulus cloud, which was the visible evidence of a stream of rising air, might give rise to a thunderstorm. Unless, however, the rate of temperature from the ground upwards was very high thunderstorms would not develop. A knowledge of the temperature gradient was thus very important in the prediction of thundery weather, and Lieut. Douglas put in a plea for the use of the aeroplane in peace time for this purpose, as, in addition, the field of view at a height moderate for an aeroplane was so extensive that distant thunderstorms could easily be observed. He himself had seen clouds 100 miles off from a height of 8,000 feet. The observations made had been quite secondary to observations of a military character, and represented only a very small part of what could be done for meteorology by aeroplane observers.

Science

Handbook of Aboriginal Remains.—The Bureau of American Ethnology hopes to complete this year the compilation of a Handbook of Aboriginal Remains East of the Mississippi. Letters have been sent to county officials in New England and the southern States requesting information regarding the location of ancient village sites, burial places and other traces of aboriginal occupancy in their respective areas, and a large body of data has thus been collected.

Gregorian Calendar Adopted in Turkey.—According to a Reuter press despatch of January 30th, the Turkish parliament has adopted the Gregorian calendar in place of the Mohammedan calendar. In the latter the year consists of twelve lunar months, and its length is therefore only about 354 days. Hence the beginning of the Mohammedan year, or "first of Muharram," occurs at different times according to our calendar and the astronomical seasons. The current Mohammedan year, the 1335th of Hejira, began October 28, 1916.

Contagious Abortion of Cattle is, with the exception of tuberculosis, the most serious cattle disease in this country, and is fast approaching first place. According to a bulletin just issued by the Department of Agriculture, the annual loss from it was estimated some years ago at $20,000,000, but it has since spread rapidly and widely. Hence the urgent importance of a systematic campaign against it. The Department states that no reliable cure is now known, and advises against the use of several remedies heretofore recommended as specifics. Preventive measures are fully described in "Farmers' Bulletin 790."

Standard Samples for Calorimetry and Pyrometry.—The Bureau of Standards sends out samples of benzoic acid, naphthalene and cane-sugar to chemists and engineers for use in standardizing calorimeters used in testing the heating values of fuels, foods, etc. During the past year 257 of these standard heat samples were issued to industrial establishments using large supplies of fuel, as well as to chemical manufacturing plants, and university, technical, municipal and other testing laboratories. A more recent analogous undertaking is the issue of standard melting-point samples for use in checking the accuracy of pyrometers. The Bureau has secured for this purpose a supply of especially pure samples of copper, aluminum and zinc.

Some Remarkable Geophysical Investigations are in progress in New South Wales, where the government is constructing a huge irrigation reservoir, which is to have a height of 236 feet and a storage capacity of 30,000,000,000 cubic feet of water. The reservoir is situated at Burrinjuck, on the Murrumbidgee. Dislocations of the earth's crust under the enormous weight of this water are to be studied by means of special forms of pendulum installed in shafts in the steep hillside enclosing the reservoir. The instruments, which are already in operation, have recorded earth-tide, earthquake and fault movements satisfactorily, as well as slow deflections from the vertical apparently related to the action of the water load. A preliminary report on the subject has been communicated by L. A. Cotton to the Royal Society of New South Wales.

Radio Equipment for Lighthouses. The Bureau of Standards has recently been engaged in efforts to promote safety at sea by means of radio instruments. A complete 1-kilowatt equipment for radio communication has been designed for installation in a lighthouse, and another has been installed on a lighthouse tender. A fog-signaling apparatus for lighthouses has also been designed. This will send out automatically a characteristic signal once every minute on a short wave-length, so that it may be readily received by all vessels within a few miles of the lighthouse. As a complement to this device, a simple type of direction finder has been designed for ships. With this apparatus vessels will be able to get their bearings from a lighthouse which is sending out fog signals, and it will also be useful for other purposes. Models have been constructed for receiving both long and short waves.

The Atlantis Question Again.—In a recent lecture before the Royal Geographical Society of Madrid, Prof. L. F. Navarro traced the history of what may be called the "geological Atlantis;" viz., the land area that once extended continuously from Europe to America. The subsidence of the greater part of this continent must have occurred so early with respect to the development of mankind as to leave no trace in human traditions. If the Atlantis tradition has any historic significance, it probably relates to some event of minor importance, such as the separation of an archipelago from the mainland. As the Canary Islands have, of all the various Atlantic archipelagoes, retained the nearest connection with the adjacent continent, biologically and geologically, and are doubtless of the most recent origin, their separation may have been late enough to give rise to the tradition. Further study of the geological formations of the island and continental shores and detailed soundings between them might fix the date of separation.

Automobile

A Spark Plug Trouble.—Although the spark plug of to-day is a highly perfected and very efficient instrument it is subject to a number of annoying troubles, some of which are decidedly difficult to locate. One of these is a faulty contact which may develop in the point attached to the body of the plug. When this point is simply riveted in the vibration of the engine frequently works oil into the joint, where it causes a poor contact, and this trouble constantly increases as time goes on, and is seldom recognized. The point connected with the body should form an integral part, or be brazed or welded in solid.

Economy in Tires.—Tire renewals constitutes a serious item in the upkeep of a car, and this is so clearly recognized by automobile owners that they too frequently postpone an examination of their tires until much avoidable damage has been done. Frequent inspections are desirable, and if defects and injuries are promptly made good as soon as they occur the increased mileage secured will much more than make up for the cost of the repairs. Instead of this the usual practice is to endeavor to forget a disagreeable necessity and let the tire run until a blow-out occurs that calls for a new tire, generally long before it would have been required if a little care had been devoted to it from day to day.

Guarantees.—The question of guarantees on automobiles is constantly attracting more attention. At present, if a defect develops in a new car the owner has to send the faulty part to the maker at his own expense; and upon receiving the replacement he often has a pretty bill to pay the garage man for putting it in—not to speak of the loss of the use of the car meanwhile. This does not seem right. On the other hand, no reputable automobile manufacturer knowingly uses defective material, although there are some who will "take a chance" on doubtful parts if there is a little money to be saved by the operation. Then again it does not follow because a man is able to purchase a high-class car he is strictly upright, and would hesitate to take advantage of the manufacturer if a promising opportunity occurred; so it is evident that the manufacturer is entitled to some protection. How the problem is to be solved with equity to both sides is difficult to determine; but the establishment of numerous service stations will undoubtedly be an important factor in working out some new method of adjusting claims.

The Fuel Question.—With the continued advance in the price of gasoline, and the difficulties in using kerosene, the question of alcohol is again coming to the front. The sources for making alcohol are so numerous and cheap, and the process so simple that it seems a pity that the production of this valuable fuel is not sufficient to be of practical use; but governmental restrictions are so onerous that only a large concern can at present undertake its manufacture, and as matters now stand these restrictions could result only in another monopoly which could set its own prices. If the regulations could be modified many a farmer could easily make all the alcohol he needed for his own use, for alcohol can be made from potatoes, barley, rye, apples, corn, corn stalks and cobs, sugar beets and a host of other materials obtainable on the farm, many of which are now waste materials, but the fear that he will drink it instead of using it for technical purposes is at present too strong for our legislators to take a practical view of the question. Possibly when strict liquor laws prevail throughout the country we may get around to a realization of the amount of valuable material that we are now wasting.

A Matter of Fashion.—It used to be said in a certain "down east" community that no woman in that town could claim a standing in society unless she had a set of false teeth and a melodion. It made no difference if she already had a first-class outfit of natural teeth, or whether she had any musical ability, for the edict of the social leaders prescribed the "store teeth" and the doleful instrument. Principles of a similar kind have prevailed in automobile circles for a long time, for many people considered that a man's standing depended upon his possession of a seven-passenger car, and many a wretched owner has rattled around among the rear seats of one of these joy wagons, for which he had no use, when he would have been satisfied, happy and comfortable in a smaller car that was far better adapted to his purposes. Fortunately the second-hand market is now putting out seven-passenger cars in such numbers, and at such prices that their possession is no longer a social recommendation; and as a consequence there is a decided tendency among new purchasers to give more consideration to their actual needs and preferences, and the size of their families when selecting their new cars. This is a healthy tendency, for hitherto there have been many who would have liked to own a car, but who hesitated to encumber themselves with the chariot that fashion prescribed. These people will now buy a smaller and more suitable car for their uses; but not necessarily a cheap car, and in the long run the change will be a benefit to the trade.

Our Eagle Learns to Fly

What Is Being Done at the Mineola Army Aviation School in the Way of Laying a Substantial Foundation for America's Air Fleet

The U. S. Army hangars and aeroplanes at the Mineola aviation school

AT a fair estimate the United States Army is at least five years behind the leading Powers in the matter of military aviation.

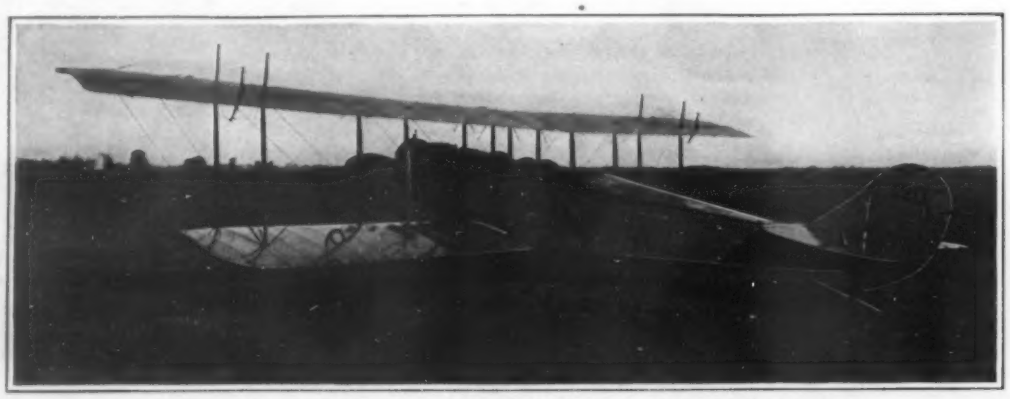
Years ago the leading powers, fully cognizant of the important rôle the aeroplane was sure to play in modern warfare, set about building up efficient air fleets so that they would not be found wanting at the critical hour. Without precedent to go by they were confronted with such problems as the training of the personnel, the standardization of the equipment, the formation of suitable organizations or flight units, and constant experimentation with a view to making the aeroplane an efficient engine of war. And it is this very pioneer work that is to-day asserting itself on the battlefields of Europe; and America, now fully aroused to the importance of aerial preparedness, learns with some sorrow, perhaps, that there is no short cut to an efficient air fleet. What other powers have done, the United States must do—and do it just five years behind time.

That we are tackling the problem of aerial preparedness in grim earnest is immediately evident to the visitor at the Mineola (Long Island) Army aviation field, and, what is more, with every promise of eventually making up for the years of inactivity. While there are many days at this time of the year when the muddy condition of the ground and the gale-like winds preclude even the thought of practice flights, the men are turning their attention during such days to the laying of roads and walks, the erection of numerous buildings, and in other ways building up the aviation colony at Mineola.

The original plan of the War Department contemplated the tests of civilian aviators with a view to their subsequent assignment to duty on the Mexican border during the summer of 1916. For that purpose, Mineola was selected as a testing ground, chiefly because of its prominence in eastern aviation circles. Lieut. J. E. Carberry was ordered to Mineola in June and assumed active charge at the aviation station July 22d. As the likelihood of active service on the border grew less and less, these plans were gradually altered, so that instructions were finally issued to assemble a force and equipment capable of training fifty student aviators.

The 1st Aero Company, N. G. N. Y., had been in camp at Mineola from the time of mobilization, and after the Columbus massacre had been mustered into the Federal service. It possessed previously owned equipment of four service aeroplanes in more or less active use. The first Government-owned aeroplane arrived at the station about August 2d.

Meanwhile, the 2d Aero Company, N. G. N. Y., a military organization which was never mustered into the Federal service, was ordered to Mineola from its home station at Buffalo, N. Y., and arrived at Mineola about July 20th. It was returned to Buffalo September 18th, while the 1st Aero Company was mustered out of the Federal service on September 23d and November 2d, and the commissioned and enlisted personnel of the regular service, with few militiamen who were retained for the purpose of receiving aviation training, were left to continue the work of the station.



A standard Curtiss 90-horse-power tractor biplane, provided with dual controls and used for training purposes at Mineola

Since then the work has steadily gone on at Mineola, under the supervision of the Signal Corps officers headed by (now) Capt. J. E. Carberry. Not alone has it fallen to the lot of the Mineola school to train civilians and soldiers as aviators, but the officials have had to work out a great many problems, of which a large number still wait solution. Some of these are the systematizing of training, the planning of an efficient organization for the flying arm of the Army, the preparation of specifications for what should constitute an ideal aviation station and an ideal training station, and the selection of machines and accessories best suited to our needs. Thus the personnel at Mineola have been veritably buried under a mass of detail work aside from the original plan of training men to fly.

The number of men who have been tested for the position of instructor is thirty-four. At present there are thirteen instructors on duty at the station, of whom seven are student-instructors in process of training, the remainder being classed as junior, senior or chief instructors, depending upon their ability and length of service. In addition, eight civilians have been passed at the station through the Reserve Military Aviator or R. M. A. flying test, six of them having been trained under the supervision of Mr. P. H. Carroll at the private training school at Governor's Island, New York. On January 31st there were nine officers and 146 enlisted men on duty at the station. The payroll, including the aviation instructors in the Eastern Department who are paid from this office, now carries eighty-nine names.

As has been previously said in this article, little time can now be devoted to preliminary training because of unfavorable ground conditions and the weather. While the latter does not hinder the training of advanced pupils who are flying alone, it seriously impedes the progress of instruction for men who are just commencing.

It is not intended, therefore, that training of a preliminary nature will be conducted on any large scale until the late spring or summer. A vast amount remains to be done and is now in progress toward organizing a personnel, and particularly toward the formulating of methods which will be used in training reserve military aviators during the coming summer and fall.

The main need of our Army at the present moment is fliers—plain fliers—to the number of about 1,000. Until December 31st last, over sixty men, civilian and militiamen, were instructed in the plain art of flying at Mineola. Some of these were given their initial training only, being unable to remain a sufficient length of time to complete the work; others finished their training. Right here arises an important point that is too often apt to be

Winter activities at the Mineola Army aviation school: At left, laying a side-walk through a sea of mud; at right, erecting one of several new buildings for housing the colony of airmen

Suit now worn by American airmen | A fur-lined suit now under test | A French flying suit | Another French flying suit | Suit of the British airmen | An American suit now in use

A few of the winter suits for airmen, which have been tested at the Mineola flying ground

overlooked: A man cannot learn to fly by devoting odd moments to his training. While it may be true to some extent that a man can be trained in the rudiments of military service in a month's time, according to the Plattsburg plan, an aviator can not be made in spare moments or during vacation periods. It is estimated that an individual must devote three or four months to constant training to become a plain flier—that is to say, until he can fly alone. Men have been known to master the handling of an aeroplane in less than a week's time, but the time required usually mounts up to thirty or forty days, with twenty-eight days as the present average at the Mineola school. However, with the training standardized it is expected that the average will be reduced, during the coming summer and fall, to fifteen to twenty days.

For the purposes of training, the type of machine now in use is a Curtiss tractor biplane of 90 horse-power, provided with dual control. Formerly it was considered good practice to teach flying by the "grass-cutting" method; the initial work of the student consisted of maneuvering a low-powered machine about the aviation field in order to become accustomed to the controls. Being of insufficient engine power, the machine was unable to take to the air, so that the student had to confine his early efforts to *terra firma*. By gradual steps the student was trained in the handling of the land machine, a low-powered aeroplane, and finally the high-powered standard aeroplane; but this method was found wanting in several respects and consequently was abandoned at the San Diego Army aviation school back in 1913.

The present practice is to take the student up in a standard machine which has its seats arranged in tandem, and which is provided with a dual set of controls. The student, following the motions of the instructor, soon familiarizes himself with the functions of the controls and proceeds to handle the craft under the supervision of the instructor, who, with a set of controls at his disposal, can immediately rectify any mistakes the student may make. From all reports it appears that the Curtiss 90 horse-power tractor is an ideal machine for training purposes.

After a student has completed his training to a point where he can fly alone, he is ready to pass the R. M. A. test. The men trained at Mineola must have put in at least 20 hours in the air before they are permitted to take the test, but men trained at other schools are allowed to pass the test purely on their merits. Opportunity is given to civilian aviators of prominence to qualify for the R. M. A. rating, so far as the flying test is concerned.

The aeroplane equipment of the Mineola school now consists of twenty-seven machines of which twenty-two are Curtiss, two L. F. W., and three Standard. There are on order for this station twenty-one aeroplanes.

Aside from the activities just referred to the Mineola station has conducted in the past, work of an experimental character because no other facilities existed for the carrying on of this work, awaiting the opening of the Aviation Proving Ground at Hampton, Va., where a new $1,500,000 station will be opened during the summer for the purpose of testing and experimenting with all types of aircraft and accessories incident thereto. Necessarily, experiments of more or less importance were assigned to the Mineola station during the past few months, among them the testing of the Barlow aerial bomb on four different occasions. The first successful test, so far as is known, of a projectile dropped from aircraft and detonating above ground was conducted at this station during the past summer. No better conception of the importance of the experimental and testing work could be obtained than the following list, covering the period from July 22d, 1916, to date:

TESTS CONCLUDED: Sireno horn (for signaling purposes); the Martin aero-dynamic stabilizer; the Macy stabilizer; the Mottlau camera; the Ogilvie air speed indicator; gasoline hydrometers.

TESTS IN PROGRESS: Sperry aeroplane map case; Sperry instructograph; aviation wearing apparel; Haustetter one-half hour barograph; the Jules Richard thermo-barograph; tourist's multiple camera for aeroplane photography; the Foxboro air speed indicator; the Sperry single fin angle of incidence indicator

(*Concluded on page 187*)

A collection of photographs taken at various times by Army airmen flying over Long Island. These are to be used as the basis for an aviation map of the vicinity

Where Science Comes to the Aid of Industries

What the Mellon Institute of Industrial Research is Doing for American Manufacturers

A NUMBER of years ago two scientists were walking through the gardens of Amsterdam, one was the well-known chemist, van't Hoff, the other the distinguished botanist, De Vries. Their fields of activity were apparently not contiguous. Chance brought them together on this particular day and it was the casual remark of the botanist that directed the attention of the chemist to the problem of the rise of sap in plants. Van't Hoff displayed such an interest in the matter that De Vries referred him to Pfeffer's book on osmotic researches and the distinguished chemist went home to study the problem. Six weeks later, van't Hoff developed the theory of solutions which has revolutionized analytical chemistry. The far-reaching results of that work are immeasurable.

The moral that may be drawn from this incident is self-evident. The association of men working in widely different fields is frequently productive of most important scientific discoveries. It explains, for instance, the wonderful efficiency of a large laboratory in which men are engaged in pursuing investigations that apparently have nothing in common. If we take the individuals of any such laboratory, set them apart and isolate them from their fellows in other fields of activity, the sum total of results will fall short of that attained by letting the men touch elbows with each other.

There are not many concerns large enough to support a research laboratory of adequate proportions. In this great country of ours we have paid very little attention to research, much of the work that has been done in the past has been sporadic and confined to the efforts of individuals here and there. It is true that there are a few well-equipped private research laboratories, but if we are to attain a commanding position in the scientific development of our industries, we must have large national laboratories where the research man is one line of study may associate and coöperate with his fellows in other totally different fields of endeavor.

About a decade ago, the late Dr. Robert Kennedy Duncan, while attending the Sixth International Congress of Applied Chemistry, in Rome, conceived the idea of establishing a research laboratory in this country which would be open to all classes of industrial problems and by which the industries concerned would obtain the benefit of the best of chemical talent and equipment at a minimum of cost. Having investigated the research laboratories of Europe he found that a large proportion of the work was kept hidden from the general public so that science did not receive the benefit it should from such intensive research. It is so easy to conceal the details of a chemical process that there has not been the proper incentive to patent chemical inventions. The consequence of this attitude has been to retard the progress of scientific development in the field of chemistry. This it was that Dr. Duncan hoped to avoid in his new research laboratory.

The plan that he evolved was to permit industrial concerns to establish fellowships in the research institute. The donor of the fellowship would furnish a sum of money sufficient to pay the salary of a research fellow, or a group of research men, for a term of one or more years. The fellow would devote practically all his time to the investigation of a problem presented by the donor of the fellowship. This work would be done in a well-equipped laboratory, under the guidance of an efficient staff of directors. At the expiration of the fellowship, if the results attained justified it, the fellowship might be renewed for another term. All the discoveries made by the fellow would become the property of the donor and would be kept secret for a term of three years. During this period he would be able to obtain patents or perfect his processes of manufacture, so as to obtain a commanding lead in the industry as the result of these discoveries. At the expiration of the three-year term, however, the matter was to be made public, thereby enriching science and enabling others to make use of the knowledge obtained. As the work of the fellow was likely to result in great benefit to the donor, the latter would agree to furnish a bonus, which in the opinion of a Board of Arbitration, would be deserved by the fellow of the fellowship.

This plan, which was first put into operation at the University of Kansas, met with immediate success. Soon after its inauguration, Dr. Duncan was called to the University of Pittsburgh to establish there a similar research system. This system is now in operation in the Mellon Institute of Industrial Research under the directorship of Dr. Raymond F. Bacon, who succeeded Dr. Duncan upon his death two years ago. It is a benevolent institution, not being dependent upon the donors of fellowships for its support. The donors merely pay the salaries of the research fellows. All other expenses are borne by the Institute. Last year there were thirty-six industrial fellowships and the expenses of the Institute were $72,000. Each donor was therefore receiving an average of $2,000 worth of assistance in the form of equipment, housing and the expert directing of his research fellow, or fellows.

The work done at the Mellon Institute is of the most varied character. There are now 42 industrial fellowships in operation and the work that they are doing ranges from the coking of coal to the baking of bread, and from the washing of clothes to the filling of teeth. As an evidence of the appreciation of the Mellon Institute, it is interesting to note that the Canadian government has endowed a fellowship to solve the problem of separating asphalt from very fine sand so as to make available for commercial use certain large deposits in the Dominion. This problem has been solved in the laboratory and it is now undergoing a test on a commercial scale.

Outside of the Institute proper may be seen a number of small buildings, which are mere shacks. While they do not add to the appearance of the surroundings, they offer concrete evidence of the practical results in the laboratories. When a line of research has developed to such a point that it appears successful in the laboratory there is still another question to be answered: Can the laboratory conditions be reproduced successfully on a commercial scale? Often this may be determined satisfactorily without experiment, but in many cases it is only by actually trying the process on a commercial scale that the success or failure of a process may definitely be determined. For this reason so-called unit plants are built where commercial conditions may be reproduced on a scale sufficiently large to prove their success or failure. These shacks, therefore, represent the commercial tests of successful laboratory research, on such a scale as would be impossible of operation within the limited confines of the laboratory itself.

The Mellon Institute has been wonderfully successful in solving the many problems given it. To be sure much of it is still sealed within the three-year term of secrecy. Some time ago the SCIENTIFIC AMERICAN published an article on "Salt Rising Bread," which described the work of one of the first fellowships at the University of Kansas. The same fellow is now at work at the Mellon Institute, where his research for a large bakery in New York city has resulted in further improvements that are credibly reported to have saved the bakery as much as $1,000,000 per year. The story of some of this work is soon to appear in the SCIENTIFIC AMERICAN. On another page we tell of the work of a fellow engaged in the problem of obtaining an ideal dental filler. Other stories of practical work accomplished by scientific research are to follow and it is to be hoped that they will arouse an interest in scientific research among our manufacturers which will lead to the establishment of other research institutes.

Perhaps one of the most surprising features of the Mellon Institute is the recent establishment of a professorship of research in pure chemistry. One would hardly expect to find such an appreciation of the value of pure science in an institute devoted entirely to industrial problems. History is full of examples of the practical or industrial value of pure science research. The very work of van't Hoff referred to in our opening paragraph was pursued without any thought of its industrial value, but we now see what an important part it plays in the glass industry, in the steel industry and in fact, in an endless variety of chemical activities. It is only natural therefore, for an institute founded upon broad lines, to appreciate the value of pure science and realize of what immense benefit it may be to the men engaged in the pursuit of applied chemistry. Already the department of research in pure chemistry has borne results and in a number of instances investigations which were undertaken purely for the attainment of scientific information have found a practical value in the industrial sections of the laboratory, and, in turn, the latter have contributed much that appears to have no immediate application, but is of value to pure science.

Although the various fellowships work in secret they operate under a common directorship, and the discoveries of one research fellow may by agreement with the donor, be employed in the work of another fellowship. This interchange of scientific information and methods of procedure is facilitated by the fact that no competing industries are allowed to endow fellowships at the institute. As a result of this association and coöperation, the work of the Mellon Institute has attained a high degree of success and it is proving a most important factor in the industrial progress of our country.

A New Cheap Substitute for Meat

EVERY one knows that shortage of foods is one of the greatest dangers which affect the population of Germany. This fact stimulated the ingenuity of several German chemists who recently invented different processes for the production of new foods. Among these new methods, one seems to be particularly interesting because probably valuable not only for present use in Germany, but for general adoption everywhere at any time, even after the war. We give its description from a recent issue of the *Lausanne Bibliothéque universelle*.

It is a very well known fact that common yeast is very rich in nourishing elements. Comparison between the figures showing the composition of yeast and of meat affords the following striking figures:

	Proteins	Fats	Carbon hydrates	Calories	Price (per kgs.)
Beef	19.5	7.	0.	168	70c
Common yeast	50.5	3.	29.	362	40
Mineral yeast	46.5	3.	26.	352	50

Unfortunately common yeast cannot be used as food because of its bitter taste. Several chemical processes were invented to transform this by-product of distilleries into food of pleasant taste, but the inventors have not been very successful; the only alimentary use of ordinary yeast is in the preparation of artificial flavorings giving to hot water the appearance and taste of "bouillon."

But German chemists have learned how to prepare a veritable food with yeast by taking, instead of the alcoholic yeast, another kind of ferment—the mineral yeast. This grows in a mixture of water, molasses and ammonium sulfate, the salt furnishing the nitrogen to form the precious proteins of the yeast. Growing very fast in a liquid made from cheap materials available in large quantities, the mineral yeast can be obtained at a lower price than meat, although its nourishing power is, as we saw before, twice as large as that of beef.

To be of practical use, the new food must meet three requirements. It must be easily assimilated through the processes of digestion, it must be pleasant to the taste and convenient for the cook, and it must not harm the body even with a continual and extensive use. Since the mineral yeast is produced as food in large quantities by the important Elbe starch plants, numerous experiments have been made touching these questions and the real value of the product is now definitely fixed.

The experiments of Woolts and Bauderexel show that the average percentage assimilated during the passage through the human body is as high as 86. While very satisfactory, this is not as good a showing as that made by meat. In addition to its successful use in the kitchens of many private houses and public institutions, Wintz, Borinsky and Noorden have added the yeast to various soups, to mashed potatoes, carrots, beans, peas and cabbages, even to puddings, without in the least altering the taste of these dishes. The same experimenters have determined that with a daily dose of 10 grams, which according to the table would permit a per capita saving of 20 grams of meat each day the health of the consumer is in no way affected. By progressive increase it was shown to be possible to give 100 grams daily without injury.

Disasters to Marine Life Due to Fresh Water

IN a recent presidential address before the Royal Society of New South Wales on the [illegible] of the Sydney beaches, Mr. Charles Hedley described some remarkable effects of temporary diminutions in the salinity of ocean water. In 1866 and again in March, 1891, sudden and widespread mortality occurred among the sedentary intertidal organisms of Port Jackson. Oysters and mussels were exterminated over a wide area and the stench from the mussel beds became unbearable. In places all the limpets and periwinkles were found to be lying about, with the animals decaying in their shells. In some areas half the fauna was dead. Mobile creatures, like fish and crabs, withdraw from the putrefying beach to deeper water. Dense swarms of a microscopic red Glenodinium were believed to have suffocated the mussels and oysters by clogging their gills, and the corruption spread by the death and decay of these bivalves spread destruction through their neighborhood. The waters of the harbor were discolored with streaks and patches of blood red.

The immense development of this organism was attributed to heavy rainfall, which combined with calm weather, diminished the salinity of the surface water. Japanese fishermen are familiar with sudden and mysterious disappearance of animals and plants from certain reefs, which are then described as "burnt." This is said to be due to fresh water pouring out of a river in heavy flood, and projected by coastal currents upon the affected area. The marine algæ die in fresh water, and their death carries destruction to their associates.

The International Catalogue of Scientific Literature

THE progress of this important undertaking has been considerably embarrassed by the war, owing to the impossibility of collecting money from subscribers in Germany, Austria, Hungary, Belgium and Poland. The publication of the thirteenth annual issue was made possible by a special grant from the Royal Society of London. The Carnegie Corporation of New York has made a grant of $6,000 toward the publication of the fourteenth annual issue.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

The Battle-Cruiser Controversy

[Because of the vital importance of the electric-drive controversy, involving, as it does, the 16 capital ships of the three-year program, costing when completed some $400,000,000, we have submitted Rear-Admiral Griffin's letter to Mr. Curtis, so as to be able to present the two sides of the controversy in the current issue.—EDITOR.]

To the Editor of the SCIENTIFIC AMERICAN:

I have your letter of the 1st inst., enclosing a copy of a letter from Mr. Charles G. Curtis in regard to the machinery installation for the battle-cruisers, and thank you for the opportunity offered to make reply thereto:

The subject has been very fully covered in my letter of January 5, 1917, to the chairman of the Naval Affairs Committee of the House of Representatives commenting on a similar letter from Mr. S. S. Wheeler; and I do not think that further comment from me is necessary, beyond correcting a few misstatements that were not included in Mr. Wheeler's letter.

Mr. Curtis says that Mr. Lovekin stated in a letter to the Secretary that the total weight "of the ship" would be over one thousand tons more with the electric than with geared drive. Mr. Lovekin did not make such a statement: He said that the weight "of the geared outfit" would be over one thousand tons less than that of the electric drive. He also said that it would be necessary to add "about two hundred and ninety tons of extra armor" in the ship with the geared drive. There are other important matters that enter into the weight *of the ship*. One of these is the fuel necessary to give a certain radius of action. The fuel consumption guaranteed by the Fore River Company at 10 knots is 11.5 per cent greater with geared drive than with electric drive. This means that, in order to obtain the radius of action contemplated in the design, the ship with geared drive would have to carry 589 tons more fuel than the one with electric drive. The weight *of the ship* as affected by machinery and fuel will stand thus:

	Tons	Tons
Electric drive heavier than geared...	...	1,000
Additional armor with geared drive..	290	.....
Additional fuel with geared drive....	589	.....
Total additional weight on account of geared drive.....		879
Difference, in favor of geared drive.....		121

Accepting Mr. Lovekin's weight as correct, the difference in weight *of the ship* is, therefore, 121 tons in favor of the geared drive; but this figure for weight of machinery is far in excess of the actual weight, and no account has been taken of the additional hull weight that will be necessary on account of the rearrangement necessary with geared drive. When these are given proper consideration, the resulting *weight of ship* will be much less for the one with electric drive than for that with geared drive.

Mr. Curtis seems to think that because electric drive is used in one type of ship, we should, to be consistent, use it in all. I had supposed that he was a better engineer than that.

His statement that the engineers of the Bureau of Steam Engineering thought the electric drive would be lighter than geared drive has no foundation in fact. Had we thought so, we should not have used geared drive in the scouts and destroyers.

As to stealing a march on foreign navies, we have long since been forced to the conclusion that it is practically impossible to keep secret any of our undertakings; and experience with the design of the battle-cruisers has shown conclusively that some of the American engineers and shipbuilders to whom the plans were sent in confidence are unworthy of the trust that was reposed in them, and that, despite their protestations of patriotism, they may be depended upon to keep foreign governments fully informed regarding our designs.

Only two of the 22 members of the Naval Consulting Board have written the Secretary in the matter; others to whom the propagandists appealed refused to write; and Prof. Webster has openly opposed Mr. Curtis' propaganda.

Nine people (not all engineers), including Mr. Curtis, have written to the Secretary, all asking that the design of machinery be referred "to an impartial board of competent experts." None of them suggested how this board was to be selected.

If the shipbuilders have told Mr. Curtis that as good underwater protection of the ship can be obtained with geared drive as with electric drive, as he states, their vision must be warped. It is doubted that Mr. Curtis speaks for the shipbuilders as a whole, or for all of them. Only two bid on the battle-cruisers (the Union Iron Works being, in fact, a Fore River bid) and it is generally understood at the Navy Department that the Newport News Company would not put geared drive in these ships if they could. It may be stated without qualification, that the chief engineer of that company—one of the most successful designers of marine engines in this or any other country—is unalterably opposed to geared drive for them.

The concluding paragraph of Mr. Curtis' letter is evidently an appeal to those whom the propaganda has not reached, to urge Congress to delay the construction of these ships. Such appeals were made to the Naval Committee of the House, but the unwillingness of that Committee to act may undoubtedly be taken as an evidence on their part to interfere in the design of ships, however much interested parties outside the Navy, under the guise of patriotic appeals, may protest because their royalties are endangered.

In conclusion, I should like to quote a portion of a paragraph from Prof. Webster's letter to which reference has been made. Others have said practically the same thing, but none has expressed it quite so well. Here it is:

> "If you desire to extract the milk from this cocoanut, consider this: The General Electric Company bought from Mr. Curtis the rights for the manufacture of the turbine, except for marine turbine, which was bought by the Fore River Company. Now, curiously enough, if a turbine drives a screw propeller directly or through gearing, it is a marine turbine, but if it drives a dynamo it is not. Consequently with the electric drive, the Fore River Company cannot build the turbines, although it has all the equipment for building them. The turbo-generator, including engines and dynamos, must be built by the General Electric. Does this explain why the Fore River Company 'showed' the Secretary something 'equally as good?'"

I have submitted this for the perusal of the Secretary of the Navy, who authorizes me to say that he does not care to discuss Mr. Curtis' letter.

R. S. GRIFFIN,
Engineer-in-Chief, U. S. Navy.

Navy Department,
Bureau of Steam Engineering,
Washington, D. C.,
Feb. 5, 1917.

To the Editor of the SCIENTIFIC AMERICAN:

I beg to reply to Admiral Griffin's letter, date February 5th, published in this issue of your paper as follows:

His statement and the figures he gives regarding the saving in weight and the extra armor based on Mr. Lovekin's letter do not correctly represent the facts at all and are of no real value in arriving at the truth in this important matter. He includes in his calculations on the Fore River design 290 tons of additional armor; whereas this company has already stated definitely that there is practically no additional armor required and what difference there is is negligible. This fact has already been brought to the attention of Admiral Griffin in the reply by Mr. Wheeler to his letter of January 5th, but he continues to ignore it.

The facts in regard to Mr. Lovekin's letter and his design of battle-cruiser with geared turbines are as follows. When Admiral Griffin's letter of January 5th appeared I asked Mr. Lovekin, who is the Chief Engineer of the New York Shipbuilding Company, for a confirmation of the facts stated in his letter and he replied that in the original geared drive arrangement worked out by his company there was, as stated in his letter to the Secretary, 290 tons of extra armor required, but the difference in weight between the electric machinery and the geared turbine machinery was considerably over one thousand tons so that he made the net saving to be something in the neighborhood of one thousand tons. But he informed me that he had since modified the original design so that no extra armor will be required and that he was willing to state without qualification that at least one thousand tons of the total weight of the ship should be saved after all details and changes have been taken into account. Also that this saving in weight would be accompanied by a saving in cost of at least $1,300,000.

Admiral Griffin says that the Fore River Company design required 11.5 per cent more fuel than the electric drive to cover a given radius of action at 10 knots speed. He does not however, state what the Fore River Company, in a letter attached to its bid, stated viz.:

> "By the introduction of cruising units, not shown on this company's design because of lack of time, equally good economies can be obtained at the lowest speed to those obtained by the electric drive."

He failed also to state that the plans and estimates made by Mr. Lovekin which were filed with the Department which involved geared turbines other than the Curtis type showed that the geared drive is 5 per cent more economical than the electric at this 10-knot speed. If Admiral Griffin should apply his reasoning to this case he would arrive at the conclusion that in Mr. Lovekin's design of geared drive there would be a saving of 165 tons of fuel to cover a given cruising radius so that the net saving in the weight of the ship would be 1,000 tons + 165 tons = 1,165 tons.

Mr. Lovekin's company having contracted for two battleships was not in a position to build a battle-cruiser at this time and so did not bid officially. Mr. Lovekin, however, unofficially submitted his plans and estimates to the Bureau of Steam Engineering and wrote a letter to the Secretary strongly advising against the adoption of the electric drive on the battle-cruisers and pointing out the great saving in weight and other advantages of the geared drive. In this letter he said:

> "I feel that I will be neglecting my duty as a citizen if I did not inform the Honorable, the Secretary of the Navy."

After further consideration and investigation the Fore River Company expresses itself as entirely confident of being able to save at least 1,000 tons in weight and $1,300,000 in cost, and also to place all the boilers below the protective deck by the substitution of the geared drive for the electric.

In regard to Admiral Griffin's statement that the chief engineer of the Newport News Company is unalterably opposed to the geared drive in the battle-cruisers I will say that the president of this company told me that in a conference between the Secretary and the shipbuilders immediately before the battleships were awarded, he argued as strongly as he could against the adoption of the electric drive because of its experimental character and because of its additional weight and cost, and that they favored the geared drive. His company put in bids with both forms of drive, but Admiral Griffin himself recommended the *acceptance of the bids involving the geared drive*. Admiral Griffin does not deny this. Immediately before the battle-cruiser bids were opened the chief engineer of the Newport News Company and its president both expressed to me the view that it was folly to put the electric drive in these large battle-cruisers, and that it would involve an immense increase of weight, cost and other disadvantages.

I hardly feel called upon to reply to Admiral Griffin's slurring reference to the disclosure to foreign governments by American engineers of the plans for these battle-cruisers. I, myself, am not aware of any such disclosure. His own statement, however, shows that it could do no harm. My experience is that foreign governments show no interest whatever in what we are doing in these matters. I cannot, however, repress my surprise that the Admiral should thus by innuendo and without naming the offenders cast discredit generally on American engineers and shipbuilders.

Replying to Admiral Griffin's intimation that the "milk of the cocoanut" in the opposition now widely aroused by the "electric drive" is my interest in royalties from turbines, I beg to state that my efforts to set the Navy Department right in this important engineering and military matter are not due to any royalty or commercial considerations. Such considerations would never have impelled me to undertake the task. The antagonism these efforts were likely to arouse would more than outweigh the advantage from any royalties that might result. Moreover it is quite as likely that other types of geared turbines will be adopted in these ships.

CHARLES G. CURTIS.

New York City,
February 7, 1917.

Why Is Peace?

To the Editor of the SCIENTIFIC AMERICAN:

In one of Crother's inimitable essays, he writes, "In looking over the ante-bellum peace literature, I have been struck by the entire lack of imagination. In this the peace makers compare unfavorably with the war makers."

A good illustration of this occurs in the letter by Edmund Berwick published in your issue of January 13th inst. entitled, "Those Guarantees for Permanent Peace."

Mr. Berwick refers to the fact that following the "Rush-Bagot arrangement" between ourselves and the British Empire in 1818 providing for disarmament along our Canadian frontier, we have had nearly a century of peace along our northern border, and claims that that condition is due to "the only possible real guarantee of permanent peace—disarmament."

What a lack of a comprehensive imagination he shows!

Long prior to the 1818 arrangement, and ever since, Great Britain has maintained the most powerful war fleet in the world and the United States has maintained a powerful navy.

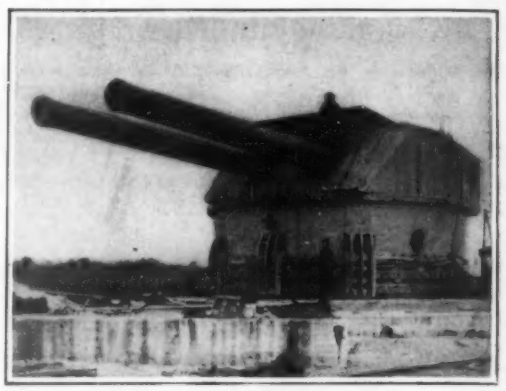
It might as well be claimed that the century of peace is due to each nation's defensive armament as to claim it due to an isolated agreement pertaining to our Canadian frontier. The truth probably is, that the hearty desire for peace between ourselves and the British Empire is the cause of our mutually good record for peace, which has extended the world over and has not been confined to our northern frontier.

F. W. GREGG.

Los Angeles, Cal.

A 12-inch gun mounted on a barbette carriage

A 14-inch armor piercing shell and charge



Two 14-inch guns in a land turret

Modern Ordnance in Relation to Preparedness

Difficulties of Its Manufacture and Intelligent Employment by Troops

By Col. O. B. Mitcham, Ordnance Department, U. S. A.

THE present great war in Europe has given many surprises to military and naval men, but no surprise has been greater than the rise and spread in our own country, since this war began, of the popular feeling for military and naval efficiency. For many years Army and Navy Officers have urged upon Congress and the people suitable preparedness for war. At last some attention has been paid to them and this great question of preparedness is being taken up by the people at large. Who would have believed two years ago that universal military training would be seriously discussed and urged by a preponderation of citizens in our own country? Yet such is the case to-day.

By preparedness are not meant merely men and guns, but what is equally an essential namely, suitable military and naval training. The results of such preparedness when combined with military efficiency has been well illustrated in the present war in the cases of Holland and Switzerland. In these countries thousands of soldiers have been kept under arms since the outbreak of the armed conflict. They have guarded the neutrality of their countries so that the curse of war has not come on either nation. All the great powers have known better than to violate their territories and thus make more enemies.

Many of the results of the war so far have been entirely unforeseen. The immense number of men under arms, the enormous problem of the supply of food, clothing and transportation, but especially the number, kinds and size of cannon of every description with the necessary ammunition, supplies and means of locomotion, have brought out problems and labor never before dreamed of, but which must be solved.

This article, however, will refer only to guns, carriages, and other artillery material connected with the actual armed contact of troops.

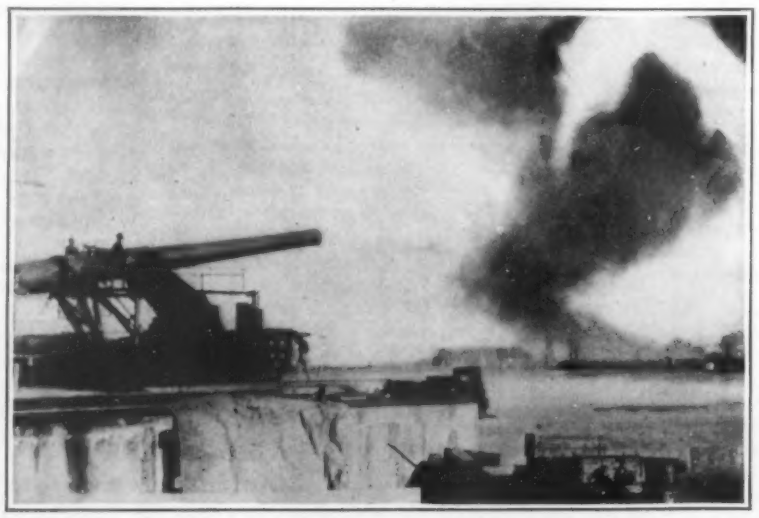
Every one is familiar with the obsolete forms of artillery material now so common in the ornamentation of parks, cemeteries, and public places in our country.

It was with such ordnance that the great Civil War of half a century ago was fought. The guns were all made of cast bronse or iron, rarely of wrought iron, and for field and siege purposes were mounted on wooden carriages strengthened with iron. There were no means of checking recoil when the guns were fired except by the use of chains, ropes or chocks. The cannoneers serving such ordnance for any length of time were subject to great fatigue in running the guns back into battery after each shot. The rate of fire was slow and in general was inaccurate at anything like ranges of extreme distance.

Even at the time of the war with Spain, eighteen years ago, there was but little improvement despite the introduction of breech loading ordnance, though bowspring brakes on the carriage wheels aided in checking recoil. Under such conditions the first requisite in modern artillery was to procure some safe, adequate and certain means of controlling this recoil due to the increased velocity imparted to projectiles and to the consequent increased pressures in the bores of the guns and increased strains on the gun carriages. Such means have been found and in general are all similar, namely the use of hydraulic cylinders to check recoil, and of counter recoil springs to return the guns into battery.

The considerations just mentioned gave rise to the present quick-firing gun, which came to the fore due to the necessity of modifying the field artillery tactics that now prevail. This quick-firing gun is the result of the elimination of all loss in time found due to the loading of the gun, aiming it and running it back into battery after firing. Loading has been accelerated by the adoption of the metallic cartridge case and of a breech block operated by one single action of the breech mechanism combined with a device for throwing out the empty cartridge case after firing. Delays in running out the gun and aiming have been avoided by allowing the gun to recoil and to return to its position on a carriage that is strongly held on the ground. The recoil systems mentioned of hydraulic cylinders to check recoil and of counter recoil springs to return the gun to battery enable field and siege guns to fire from twenty to twenty-five shots per minute. Designs of all such guns differ in nearly all countries, but the essential principles of construction are practically always the same.

These methods are, perhaps, well illustrated in our smallest gun, the Vickers-Maxim Mountain Gun of 2.95-inch caliber, designed for pack transportation on mules. The gun has two lugs, one on each side, for the attachment of the piston rods on the carriage. It has sufficient recoil on its carriage to diminish the movement of the latter, but not enough to render the carriage entirely stable; therefore ropes to aid in checking recoil are used on the wheels. The gun, after recoil has been checked by the resistance of the oil in the buffer cylinders, is returned into battery by two buffer springs that surround the piston rods and are located in the buffer cylinders. This gun, although having a rifled part of the bore only 24 inches long, fires projectiles weighing 12½ pounds and 18 pounds, and gives an extreme range of about 4,000 yards.



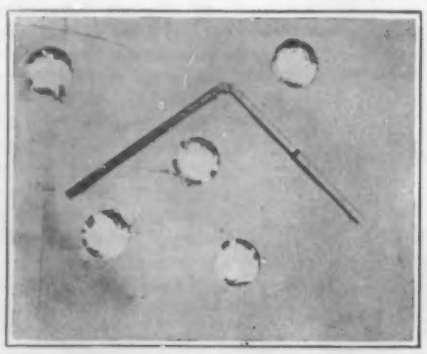
A 14-inch gun in recoil after firing

The most mobile of the guns and carriages used for field and siege services, is illustrated by our present 3-inch field gun. It is one principally depended upon in the field service of troops. In construction it is similar to all such guns used in other armies. The type of carriage is that known as long recoil, in which the gun is permitted a sufficient length of recoil upon the carriage to render the latter stationary under firing stresses. It is mounted upon a cradle that forms a housing for the recoil controlling parts. These latter include a cylinder, piston, counter recoil buffer and counter recoil springs. When fired, the gun moves to the rear approximately a distance of 45 inches in the cradle, carrying with it the cylinder and compressing the counter recoil springs. The energy stored up by the springs returns the gun to the battery. This return movement is eased and regulated by the counter recoil buffer. The shields are carefully tested at a range of 100 yards by the impact of jacketed bullets fired from a Springfield rifle, and must not be penetrated.

The accuracy of fire is shown in the illustration, which gives a target made by one of our field guns at a range of 2,500 yards. The image of the 2-foot rule shows the limited space in which these shots struck, in other words, the wonderful accuracy of field ordnance when properly served.

While both guns and howitzers of all calibers can be used for siege purposes, the most effective are usually a gun of 4.7-inch caliber firing a projectile of approximately sixty pounds in weight or else howitzers of 4.7-inch and 6-inch calibers. The present war has shown the need of heavier calibers such as 7.6-inch, 9.2-inch, 12-inch, and even larger howitzers, all of which sizes have been used in the field.

Guns permanently emplaced for land defense are known as guns of position. The illustration gives a good idea of a modern breech loading seacoast gun mounted on a disappearing carriage. The action of the gun and carriage when the piece is fired is relatively simple. The long arms on which the gun is mounted are the gun levers. Upon firing the piece these arms move to the rear, carrying the top carriage with them. The lower ends of the levers move vertically upwards bringing a very heavy weight with them. The trunnions of the gun follow the arc of an ellipse and move downward and to the rear. The tremendous



Target of U. S. 3-inch field gun at 2,500 yards

A 3-inch field gun at end of recoil after firing

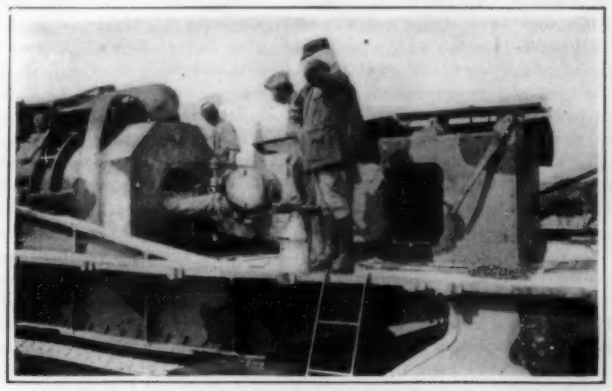
energy of the recoil is absorbed partly by raising a counterweight (in the case of a 12-inch gun this amounts to 140,000 pounds of lead), by the movement of the carriage up the inclined chassis rails, but principally by the resistance of the recoil cylinders filled with oil. The gun is returned to battery by releasing the counterweight, by which means it is forced forward into its firing position. In our service heavy guns are also mounted on what are called barbette carriages, that is, carriages for firing over the walls of an emplacement. The method of mounting and arrangement of the recoil system are quite well shown in the illustration. The largest and most powerful of all our seacoast guns at present mounted at any of our fortifications is the 14-inch gun. It fires a projectile of 1,660 pounds' weight with a bursting charge of 85 pounds of high explosive. The illustration will give some idea of the size of the projectile used in this gun and its powder charge. Such guns are sometimes mounted in turrets, similar in general in construction to those on shipboard. The largest gun to be mounted in our fortications is 16 inches in caliber. It will be placed upon a disappearing carriage, the design of which, has been perfected after a number of years of experiment.

The difficulty of moving or of maneuvering when the weight of the guns and carriages is so great must be apparent from the illustrations. The facility with which this is done in our present types of gun carriages speaks well for the designing capacity of those who have undertaken this work. At the time the 45-caliber, 16-inch gun was under consideration an expert on ballistics calculated the maximum range that could be obtained with the gun provided a suitable carriage could be designed for the necessary elevation. It was concluded that an extreme range of about twenty-one miles was possible.

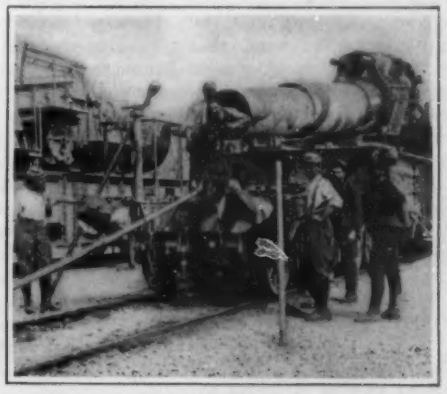
To obtain high-angle fire, so that a projectile may fall as nearly vertically as possible upon forts or earthworks, thus rendering ineffective overhead or other cover, mortar fire is generally used. The object of having such guns in seacoast fortifications is to drop projectiles on the deck of vessels so that penetration and interior explosions can be produced more readily than in the direct fire of guns. In our seacoast service mortars of 12-inch caliber are employed. Usually these mortars are mounted in series of four and can be fired electrically or by hand, in volleys or singly, as they may be required.

Much has been said of the use of such heavy mortars also in field and siege operations during the present war in Europe. The two heaviest mortars that have been most mentioned are the German 28 cm. (11.-inch) and the Austrian 30½ cm. (12.2-inch). The range of each of these guns is about eight or nine miles. Heavy guns have also been used for the same purposes as the mortars, as will be seen from the illustration showing one of these guns mounted upon a railway carriage and firing from a wheat field. All these large guns and mortars have rendered good service, but the results, as obtained when firing against ordinary field trenches, appear to be in about inverse proportion to the size and caliber of the projectiles.

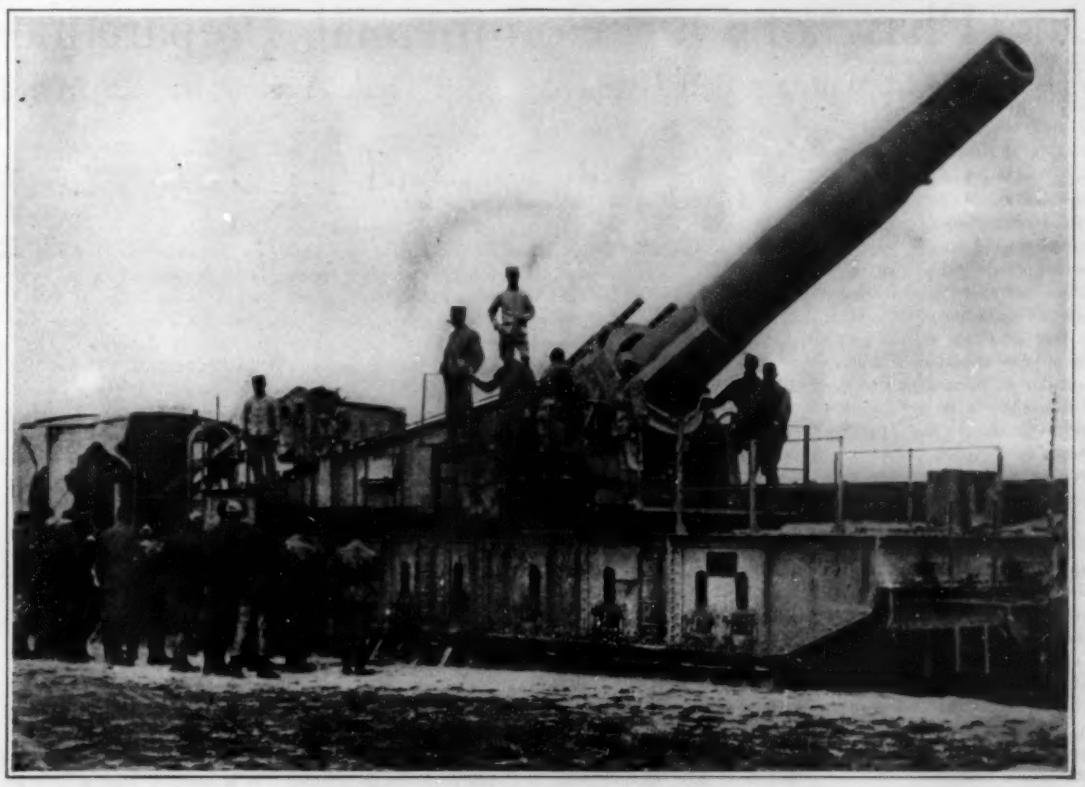
The object of this article has been to place before readers the complicated nature of modern ordnance materiel and the relative difficulty that arises in its manufacture and intelligent employment by troops. The trained soldier of the present day, whether enlisted man or officer, must be intelligent, industrious and constantly at work for self-improvement and for efficiency in the necessary details of his particular arm of the miltary service.



Gunner entering breech to climb through 16-inch French gun



A 16-inch French gun on the Somme



Heavy gun mounted upon a railway carriage

The experience gained on all sides in the present European war shows that radical changes in the employment of all forms of ordnance on the battlefield have been and will be found necessary if the full effect on the enemy's personnel and materiel are to be gained.

The Current Supplement

AN interesting article for the general reader in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2146, February 17, 1917, is on *The Energy of the Universe*, which surveys in a non-technical manner the various kinds of power provided by Nature, and how we transform and utilize them. *Pearl Fishing in the Persian Gulf* gives a very readable account of the methods by which some of the finest gems in the world are secured, and of the people who make this their business. It is accompanied by several illustrations from photographs. A paper *On a Precision Method of Uniting Optical Glass* describes experiments in the union of glass in optical contact by heat treatment that are of considerable value to the scientific world. We in America are apt to regard Italy as the playground of the tourist, and have given little thought to it as a manufacturing country. As a matter of fact Italy is fully abreast of her European neighbors, and this is exemplified in the article on *Modern Technical Work in Italy*, which is illustrated by a large number of photographs taken in one of her largest establishments, which ranks with the leading shops of the world. *The Phototropic Sense in Plants* is an unusually interesting article that shows the apparently intelligent directing functions that lead them to seek light. It is accompanied by numerous diagrams. *Photoelectric Phenomena* treats of some relations of light to long distance wireless telegraphy. The paper on *Capillary and Electrocapillary Chemistry* is concluded. There are several other articles of importance.

Preserved Blood for Food

IT is obvious that the nutritive value of animal blood should be very high, since it is the carrier of building materials to every tissue of the body. Yet there is a strong prejudice among most people against its use as food. This is partly due, doubtless, to its association with carnage and death, and partly to the survival of the influence of the Mosaic law prohibiting its use for food. However, in the desperate and ingenious search for fresh sources of nutrition which German scientists have been making at the bidding of necessity, the possibilities of the vital fluid have not been overlooked. An article in the *Berliner Klinische Wochenschrift*, details methods of conserving the blood of slaughtered animals for household uses, in these words:

"For the conservation of blood in its original form suitable preservatives are salicylic and boric acid, and especially formalin. Before using, a coagulum must be produced by heating the blood, after dilution to eightfold the quantity; in this there will remain only very minute quantities of the antiseptic substances. For limited, direct use blood may also be conserved by the addition of sugar. But, if a more general application is intended, the liquid form must be got rid of. It may be changed into powder by evaporation or after previous coagulation.

"The total coagulated mass with the above-mentioned antiseptics added yields products of varying durability, and from these the preservatives must be removed in the household by thorough grinding and adequate boiling. A semi-solid, marmalade-like mass is obtained by dissolving an equal quantity of sugar in a given amount of blood and then heating in a water bath or with steam for a short time. In this the albumen is present in an exceedingly fine state of division."

The author also advises a more extended use of the blood pudding or blood sausage," and another writer recently advocated the addition of blood to bread in order to raise its nitrogenous value. The *Chemikerzeitung* likewise quotes from an Austrian journal of chemistry in which G. Morpurgo describes a process similar to that for making glue, by which bones are made to yield a substance very rich in albumen and in fat, which can be used as a basis for soup-stock.

American Magnetic Observatories

IN proportion to the extent of its territory, the United States and its outlying possessions can hardly be said to be well provided with magnetic observatories. The Coast and Geodetic Survey now operates such establishments at Cheltenham, Md.; Tucson, Ariz.; Vicques, P. R.; Honolulu, Hawaii, and Sitka, Alaska. At the recent centennial celebration of the survey, Dr. Bauer, of the Carnegie Institution, urged the location of like observatories in the Canal Zone and in Guam. The director of the survey announces that an observatory will be established in the Canal Zone soon.

New Uses for Kapok In Great Britain

KAPOK, or the silky fiber covering the seeds of a tropical tree of the silk-cotton species found in both the West and East Indies, has for many years been used extensively in Great Britain as a stuffing for pillows, cushions, and upholstery, and, more recently, for life-saving belts and jackets. So far, it has not been used to an appreciable extent for textile purposes, although yarns have recently been made experimentally in England from the fiber. The irregularity and resiliency of kapok are said to make spinning difficult, but its high luster and the fact that it is said to be superior to fur in the matter of heat insulation seem to offer certain advantages in the manufacture of artificial silk.

Bearing upon its resistence to the penetration of liquids, it appears that alcohol or solutions thereof permeate more rapidly than other fluids and render the fiber pliable.

Scientific Search for An Ideal Cement

A Dental Problem and How It Was Solved In a Research Laboratory

IN the spring of 1914, the general manager of a prominent firm manufacturing dental supplies came to the Mellon Institute to see for himself some of the remarkable results of scientific research applied to the problems of industry. After a trip through the building where research work on all sorts of problems was in progress he said, "Well, you certainly are doing big things here, but I have a harder nut to crack. Our firm wants the ideal dental cement, one that will replace the unsightly gold fillings, yet will be durable as well as attractive in appearance."

Although the director refused to make any promises for the success of the venture, the manufacturer was so anxious to realize his long cherished dream that he decided to take a chance and to establish a research upon this most important subject. Consequently, on July 1st, 1914, Dr. C. C. Vogt began work.

The problem was full of knots and tangles. The ideal filling material must look like a tooth, fit like a tooth and wear like a tooth. In scientific terms this means that it must possess translucency, adhesiveness in order to fit the cavity exactly, a low coefficient of expansion or contraction during setting, imperviousness to the fluids of the mouth, and high crushing strength. For the sake of the patient, it must also harden quickly and be insensitive to sudden changes in temperature.

These requirements made clear the method of attack. It was necessary to find out what particular constituent or combination of constituents would produce each desirable property and then so to combine these different properties that the ideal cement should result. While how to do the thing was evident, the doing of it was quite another story.

The first step was to produce a material which would harden. So, Dr. Vogt began by reading all about the making and the hardening of dental and other cements and then tried the putting together of all kinds of mixtures in order to get this fundamental property. This library and preliminary laboratory work used up some five or six months and the results were anything but encouraging. In fact, so dark were the prospects that the superintendent said, "Vogt, I think that we can never equal, let alone improve upon, the German made cements. Why, those fellows made the first successful filling materials and, of course, they know more about it than anyone else could possibly know. I think you had better solve some of our minor problems and let cement alone." However, on the other hand, the general manager said, "I have more faith in the American brand of chemistry and in American initiative than that. We will continue the research."

By and by the work showed signs of progress and one by one the properties began to fall into line. Translucency followed setting and then along came high crushing strength. At this juncture the year's contract came to an end and the question arose, "Shall the work continue or not?" The general manager summed it up thus: "Vogt, you know more about cements than you did a year ago so, if it was a good proposition then, it is a still better one now. We will stick if you will."

Time moved along and finally Dr. Vogt learned just how to produce each desirable property. Then came the real tug-of-war—how to combine these several properties. It was like a picture puzzle—he had at hand all the pieces, but the pieces were not fitted together to make the picture. However, gradually the pieces were brought into harmony; appearance and crushing strength went in side by side and these two joined to adhesiveness and all these to non-shrinkage until presto! the puzzle became a picture—the separate qualities were united in a cement that seemed to fulfill the requirements.

Then followed a long and tedious series of measurements upon the material, in order to prove its ability to stand those physical tests that are demanded of an ideal filling material. Finally, in February, 1916, the product was submitted to the general manager for his approval. Success seemed at hand and the chemist thought that his journey was at an end.

But all these laboratory tests were not enough for this up-to-date manufacturer, and what did he do but say, "Well, Vogt, your experiments in a test tube are all right as far as they go, but what we want to know is: will your stuff stand the test of use in the mouth? The reputation of our firm is at stake and we must be sure that the material is right."

Poor chemist! He must sit around for a year after his work is done and patiently (?) await the results of clinical tests before he can hear the final word of approval. However, the tests have already been in progress for over half that year, and as long as the reports are as enthusiastic as they now are they will make mighty good reading for him while he waits.

Dr. Vogt's cement consists of a power made by finely grinding a strongly basic glass and a liquid which is a phosphoric acid solution modified by dissolved phosphates. The powder is slowly added to the liquid with thorough mixing, thus neutralizing completely the phosphoric acid and producing phosphates which act as the binding agent for the tiny grains of glass. The material is very adhesive, thus insuring a filling that "fits like the tooth," and it hardens in from five to ten minutes to a dense mass, which "looks like a tooth"—so much so that it is difficult to distinguish between the tooth and the filling. It is being established by clinical tests that it "wears like a tooth."

One Phase of Our Commercial Preparedness

What Will We Do to Maintain Our Latin-American Trade Against Inroads from the West?

By Prof. G. A. Aerts

MUCH has been said, and with propriety, about our position in the world's trade after the war, when we shall have to meet keen European competition, not merely in the effort to increase the quantity and the efficiency of the foreign trade which we have so recently acquired, but even to maintain our new-found business in the face of Europe's effort to regain her old position. As nobody knows, however, how long this war is going to last, and as the solution of this question is merely based upon speculation or on our humane desire to see the end of the monstrous calamity, it is my opinion that our attention should be given also to the situation of the moment, to actual present competition.

We know that Great Britian is, with considerable success, straining all her resources in order to increase her exports and to compete wherever it is possible under the present conditions with our own manufacturers. In spite of its subsequent voiding by the British government, the recent contract for shells awarded by our own government to English manufacturers is one of the most eloquent proofs of these efforts. We know, too, that France is reorganizing and mobilizing her manufactures and that, notwithstanding the terrific drain imposed by the war on her working force, her exports show a regular increase. We are watching these countries carefully and we are doing from our side whatever is in our power in order to meet them in the world's market.

However, it appears that we are not paying enough attention to one country which, although being nominally a belligerent, has kept out of the real war since about two years, and which is now using the extraordinary vitality, the wonderful spirit of assimilation, the known perseverance of its people, to acquire among the trading nations of the world the range and place which its previous achievements in war and diplomacy have enabled it to take among the great military powers.

We all know the great activities of the Japanese in the Orient. It does not seem to be any longer an issue that among the Orientals the Japanese will be the power behind the throne, and that on account of the similarity of customs, the facilities of communication and racial analogies, we tacitly have agreed to their predominance in the Chinese Seas. Perhaps, after the war a different settlement of this question will take place, but attention should be called to facts which at the present moment are of the greatest interest to us, which are vital to the future of our foreign trade and the continued existence of our Pan-American aims. These facts are the extraordinary activity of Japanese traders, manufacturers, and ship-owners in the Latin-American countries.

From the information which I have been able to gather, we find that during the first six months of the year 1916, the exports of Japan to South America have increased 130 per cent and her imports therefrom 154 per cent. We further find that the Nippon Yusen Kaisha has started a direct service of steamers between Japan and Brazil. The Toyo Kisen Kaisha, which already has a regular fleet plying between Japan and the Pacific ports of Latin America, is studying the question of establishing a line calling at a Venezuelan port and eventually reaching the more southern ports of Montevideo and Buenos Ayres.

Under date of July 26th, our Counsul-General at Yokohama, George H. Scidmore, forwards the following quotation from a local paper:

"With a passenger list that broke all records in the transportation of Oriental emigrants, the Kiyo Maru of the Toyo Kisen Kaisha weighed anchor from Yokohama for South American ports. Of the 931 steerage passengers all but a very few were bound for South America. Since the gentleman's agreement with the United States, the number of Japanese emigrants to South America has increased in great numbers. The policy of Australia has also made the southern continent attractive to people from this country. Yesterday's list of emigrants is said to represent the largest number of steerage passengers that ever crossed the Pacific on one ship. The steamer also carried forty-five young Japanese girls on their way to South America to become the brides of Japanese who have already located there. Brazil is most attractive to the Japanese, who find the land cultivation profitable."

It has been furthermore officially stated that Japan will send to Brazil, every year, a minimum of 5,000 emigrants. We also know that in Chile a special concession of fisheries has been granted to the Japanese; and as to Peru, the Japanese population there, which was 5,380 in 1914, has since nearly doubled. This applies only with less force to Brazil which in 1914, counted 15,460 Japanese and has now over 22,000. A report from William W. Handley, our Consul-General in Lima, dated July 22d, makes these statements:

"Considerable interest has been manifested by two of the most powerful Japanese steamship companies during the past few months in developing their service along the west coast of South America. Prior to the war these companies had no regular schedules, but now they maintain a monthly service of steamers having a tonnage from 15,000 to 20,000, and are obviously making strong efforts to capture the trade.

"It is stated that the Toyo Kisen Kaisha has recently decided to augment its service between Hongkong and Coronel, Chile, by putting on three additional steamers. These ships are to touch at San Francisco and some of the principal west coast ports of Central and South America, proceeding as far south as Coronel. The service is to be monthly.

"It is also reported here that the Mitsui Bussan Kaisha, with headquarters at Tokyo, has finished negotiations for the purchase of five Chilean steamers which ply between Punta Arenas and Atlantic and Pacific ports of South America. The steamers are the "Goni," "Valenzuela," "Uribe," "Mott," and "Boris." All will be retired from their former service and placed in the trade between Japan, Korea, and China, replacing vessels of a larger tonnage.

"The Japanese Government recently instructed the Japanese Consul-General at Lima to make an extensive tour of Chile, Argentina, Uruguay, and Paraguay, with a view to seeking commercial information for the improvement of the trade between Japan and these countries. He has very recently returned from a two-months trip, after an extensive visit not only to the seaports, but to many of the interior towns of these countries.

Under date of July 17th our commercial attaché at Santiago, Chile, supplies additional information. He states that plans for enlarging the commercial relations between Japan and Chile are mentioned by the *Mercurio* of Santiago, which on July 13th published the following:

"According to information received from Yokohama, it is learned that a company with a large capital has been organized in that city under the name Pacific Trading Company, whose chief business will be the importing and exporting of goods from and to the Pacific Coast countries. Mr. Morimoto, who has organized this company, came to this country in charge of the Japanese Exposition, and this organization is the result of the study he made of our market and also of the commercial commission which visited us a short time ago from Japan, of which Mr. Morimoto was the leader. Operations will probably begin in August."

The manufacturing facilities of Japan are, on account of its ordinarily dense population, the greatest which any country in the world possesses, and as there is not at present in Japan any serious protection whatever for foreign patents or trade marks, it will not be long before we shall see our own goods duplicated in Japan, landed at a much lower cost in those markets which, by right of our efforts, by right of the Pan-American spirit, should be ours.

This cry of warning might perhaps seem to be somewhat premature; but preparedness is never premature. The National Foreign Trade Council should make a special study of the activities of the Japanese business men and determine what we have to do to meet them efficiently and practically.

Germany the Land of Makeshifts

Substitutes and Rigid Economy the Order of the Day In All Industries

WITH her imports of so many raw materials cut off—raw materials like cotton, wool, rubber, copper and aluminum, which have seemed to be absolutely necessary to the existence of twentieth century technology—Germany has become the land of makeshifts, indeed. The good old by-word, "Accept no substitutes," has gone completely into the discard; in its place the German of to-day, be he manufacturer or consumer, may well cry "My kingdom for a substitute!" One of the most overworked words in the German language at the present moment is "ersatz," which from its fundamental meaning of "compensation," has come into general use in the sense of "substitute." Without the ersatz, Germany would indeed be in a sad plight. Not only does it come into play in the fields of metallurgy and textile manufacture, and in connection with the food problem, but it is to be found at every turn in the smaller industries. Without her extraordinary ability to improvise, Germany would have been long ago smoked out by industrial starvation.

It was, of course, in the metal industries that this ingenuity was first called into play. The problem, while a serious one, was by no means hopeless. In the inexhaustible coal and iron deposits of her own territory and the occupied regions of France, Germany had from the beginning a capital upon which to work. Wherever it was possible to make steel do the work of some other material, wherever it seemed that experiment and research might develop a modified steel to meet the requirements of some special situation, there was the assurance that the steel was to be had, and for an indefinite period.

And it has turned out that the number of rôles which steel can be made to fill is surprisingly large. It is plain enough that it can be used in place of other metals for many ordinary purposes—for all manner of vessels, for ornamental trim of one sort or another, wherever, in fact, neither electrical conductivity nor some special physical property not to be given to steel is demanded. A far less obvious fact is that it can be substituted for rubber wherever the latter is ordinarily employed for the sake of its elasticity alone, without regard to texture or compressibility. To mention one instance out of many, we have already described in these columns an automobile tire of steel wire which is in active competition with other substitutes for the rubber tire. And in addition there are many instances where an economy, small in the individual case but large in the aggregate, may be effected by the substitution of steel for hard woods, ivory, composition substances containing rubber or other unobtainable materials, and various other components which it is not possible or convenient to supply as usual.

Another metal which is doing very well in new uses is zinc. Of this, Germany has an ample supply; and her engineers have found that when steel is not a satisfactory substitute for copper, brass, bronze and tin—the metals which Germany produces not at all or in insufficient quantities—zinc is frequently acceptable. In particular this metal is finding very wide use in the making of wire for non-electrical purposes, and as a substitute for copper in the manufacture of certain classes of utensils for which its chemical reactions make steel unsuitable.

In addition to actual substitution, it has been pointed out that the Germans, with their genius for synthesis and chemical research, may well have worked out new ways of producing certain substances. Outside speculation has played most upon the theme of synthetic rubber. While so far as is known the Germans have been quite unable to effect any progress toward the realisation of this outstanding problem of the industrial chemist, it appears that in the reduction of aluminum they have put the corresponding dream of the metallurgist upon a definite working basis.

Aluminum is one of the very commonest of elements; but it never occurs in the free state. For a hundred years after its first discovery it defied all efforts to isolate it. For eighty years more it baffled all attempts at reduction upon a commercial scale. It was not until the dawn of the twentieth century that the development of electrolytic methods made this possible—and even then, only for the simple oxide. The compound oxide of aluminum and silicon, perhaps better designated as a desilicate, which forms the major constituent of all the common clays and consequently presents, with its 20 per cent aluminum content, a potential source of the metal of far greater value than the oxide, has always resisted this treatment. To be sure, it breaks down under the current. But of course the silicon wing of the rather complicated molecule breaks down with the aluminum wing; and the silicon is a very undesirable impurity and one of which it has not been found possible to free the aluminum. The recent news from Germany that means had been found to prepare aluminum from ordinary clay can mean but one thing. Under the sharp lash of necessity imposed by the cutting off of their supplies of bauxite (the conventional aluminum ore) from France, the Germans have solved the problem of disposing of this silicon, and are now in possession of a source for an unlimited amount of aluminum, a substitute metal of extreme value.

It is especially to be noted that the substitution of aluminum, zinc and steel for copper in so many of its uses has far greater effect than the mere direct lessening of the demand for copper. Every such substitution, of course, does this; but at the same time it makes possible the release of quantities of old copper from these uses to those in which there is no substitute. Door knobs, door plates, trimmings from stoves, windows, machinery and other places, kettles, even coins, have been systematically gathered up and converted into shells and carriers of electricity. In our recent resumé of economic conditions in Germany we gave a most interesting account of ways and means employed by the government for the collection of this conserved copper from the individual owners.

In passing to the textile industries, crippled by the cutting off of their customary supplies of cotton and wool, we find that the procedure by means of which substitutes are evolved is rather different from that in the metal trades. It is here not so much a matter of adopting existing materials to new uses as of finding new materials. In some cases, this means the finding of uses for substances heretofore supposed to be useless; in others it means synthetic experiment leading to the elaboration of a brand new substance. Under the second heading the Germans have brought out a great variety of modified paper pulps which can be worked into coarse thread and cloth for the manufacture of sacks and bags, aprons and other rough working garments, rope, string, etc. In the first category falls the utilization of various weeds as substitutes for cotton and wool. Thus the lowly nettle is the source of a very satisfactory "cotton batting," as well as of thread and yarn; and every variety of weed, and especially of the larger water reeds, is being subjected to a severe catechism as to the justification for its existence.

Of the food situation in Germany, we refrain from speaking here. Reports from different sources show such wide divergence that the present writer does not feel competent to attempt a sifting out of the truth. It is plain, of course, that substitutes must figure upon the German menu; but what they are, and how extensive is their use, are questions which perhaps even the average German is unable to answer to-day. We know that potato flour has been used very generally in place of the regular grains. We are led to suppose that conditions in the potato districts may, before long, force a falling back upon barley as an even less satisfactory meal. But to what extent the Germans have been able to evolve, from the materials at hand, effective substitutes for tea, coffee, sugar, chocolate, the thousand and one items which appear in the normal diet and which are not to be had in beleaguered Germany, we do not know and cannot know until after the war.

The recovery of copper from non-essential uses and the extension of the list of plant products available in the textile industries are but special aspects of a general campaign, whose slogan might well be "Waste nothing." Thus, by systematic smuggling and by means of the "Deutschland's" two trips it has been possible to get into Germany a fair amount of new, live rubber. This we are given to understand has not been put indiscriminately into the general stock of rubber, nor has it even been constituted a special stock for use in the most vital places. A process has been perfected whereby the addition of a comparatively small proportion of fresh stock to a large bulk of old, worn-out rubber, makes possible almost complete renovation of the latter, greatly prolonging its useful life. By careful utilization in this way of every scrap of new rubber, a good supply of the regenerated substance has been created which will be sufficient for some time to come.

Another phase of waste prevention is found in the desperate efforts to devise a use for everything which used to be thrown away. Thus, the Germans are very careful to throw away no fruit stones until they have been made to give up the last drop of their oil content. Cherry and plum stones in particular are very rich in oil and fat, and from them it is possible to secure large quantities of a very acceptable substitute for the more usual fatty bases required alike for industrial and military purposes. Periodic and systematic collections of all fruit stones are made in the German towns, largely through the labor of school children. One of the few pictures to come through from Germany recently, reproduced on this page, shows the magnitude which this single item of saving may attain.

Oil—a substance of vital importance—is reclaimed from these millions of fruit pits gathered by school children.

The tale might go on almost without end. Thousands of chemists and machinists are experimenting with substitutes for the ordinary lubricating oils and greases. As many motorists are trying out every manner of eccentric distillate in the effort to hit upon a successful substitute for gasolene. Synthetic saltpeter is being produced for military and agricultural purposes on such a scale that Chile has probably lost one of her best customers for good. The chemists have found or are still seeking acceptable substitutes for the $300,000,000 worth of mineral oils (including the petroleum mentioned above), which Germany imported in 1913.

It goes without saying that the German people are tremendously alive to the significance of this whole substitute tendency. So great is the public interest that an exhibition of substitute materials has been opened at the Zoological Gardens in Berlin. It is held under the auspices of the Office of Metal Control, and its promoters are the Advisory Councils for the brewery, white metal, tin and zinc alloys industries, the Upper Silesian Mining and Iron Works Union, and the Associations of electrotechnists, ironmasters, engineers and machine builders. At least eighty firms are showing substitutes for the materials used in normal times in the electrotechnical, machine construction, motors, foundry and optical industries and in the manufacture of fibrous materials. The exhibition is to remain open during the war, and is being continually enlarged. All visitors are required to sign a declaration that they will divulge nothing relating to the goods exhibited, using the knowledge gained only for the benefit of their own businesses.

Unique Type of Plow Used in Western Australia

THE fact that practically the entire surface of the areas susceptible to cultivation in western Australia is heavily wooded and that the dearth and cost of labor preclude the clearing of the land of stumps and roots, makes necessary the use of a special type of plow known as the "stump-jump." This is so constructed that it will roll over stumps and other obstructions lying on the ground. The plow was invented by an Australian and, so far, has been manufactured only in that country. In breaking up new lands preference is given to the stump-jump disk plow, as it will cut many roots that a moldboard plow would leave untouched. As the land becomes cleaner of roots after two or three years application of this treatment, the stump-jump moldboard is preferred because of its better soil turning qualities.

Science In the Lumber Industry

Tremendous Saving of Waste Products Now Being Effected Upon a Commercial Scale

By William J. Ferry

THE biggest problem to-day in the manufacture of lumber—second largest industry in the United States—is the closer utilization of waste products That is particularly true in the great yellow pine region of the South. Approximately forty per cent of all the lumber produced in this country is southern yellow pine, yet under the most economical modern logging and sawmill methods only about thirty-five per cent of the trees felled for lumber is converted into usable material Sixty-five per cent, which includes tree tops and stumps left after logging, and mill refuse in the form of outer slabs, edgings, sawdust, etc., has served no useful purpose, and has been either left on the ground to decay or burned "to get it out of the way."

That tremendous waste has not been willful, nor is it indicative of extravagance on the part of the southern lumber manufacturers. They have customarily utilized every bit of material possible under existing conditions. The problem has been to discover new uses for wood that would give a value to the great percentage of material that cannot be made into lumber. To that end the aid of the scientists has been enlisted, and the laboratories of the National Forest Service have experimented continuously during the last few years. The results achieved by chemical research have demonstrated that the waste portions of yellow pine trees may be made to yield an amazing number of useful by-products—*in the laboratory*. But recovering these by-products in an experimental way and accomplishing the same results profitably on a commercial scale are two very different things. The cost of testing out production in a large way involves the expenditure of money in staggering sums—investments so heavy that few capitalists have had the courage and confidence to undertake the rôle of pioneers in the new field.

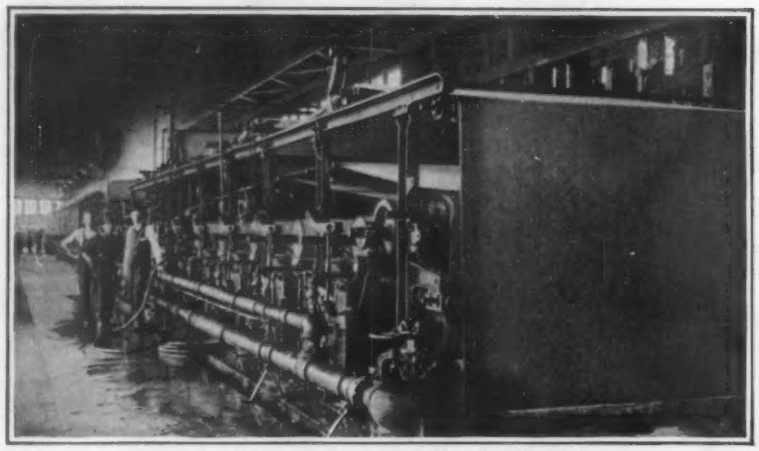
Of the few important ventures of this character that have been made, one of the most conspicuous is to be found in a company recently organized in Louisiana for the manufacture of fiber-board from the yellow pine scraps formerly burned as refuse at one of the largest sawmills in the South. The finished product of this factory is designed for use in cartons and shipping boxes. The plant has a daily capacity of between forty and fifty tons of fiber-board, valued at about seventy dollars per ton; and the output is contracted for far into the future.

In the success of this enterprise lumbermen see promise of an alluring future for the utilization of waste southern yellow pine. The man who backed the venture risked more than a million dollars in support of their conviction that the scientists were right in their assertion that profit was to be had from the manufacture of paper products from yellow pine pulp. They have proved the commercial practicability of the laboratory discoveries, and the demonstration is certain to have a profound effect in influencing future investment in plants for the utilization of wood waste. Evidence of the stimulus given this new branch of the lumber industry already is apparent at the home of the pioneer mill, where another company has begun work on a similar plant, to cost not less than a million dollars, for the manufacture of pulp and container-board. The daily capacity of the new plant will be 60 tons of pulp and 125 tons of material for cartons and packing cases. All of the raw material for the two products, as well as all the fuel required to operate the plant, will be refuse that formerly was left in the woods to rot or went into the waste burner of the lumber company's sawmill.

These big undertakings are genuine and practical forest conservation and utilization of waste. They look like the beginning of the era forecasted by an eminent chemist when he said, "The production of lumber in the South will ultimately become a mere incident in the business of lumbering." There are practically unlimited possibilities in such development.

And utilization by no means need be confined to the manufacture of paper and fiber-board. The scientists have proved that southern yellow pine is capable of yielding many other valuable by-products. Among the number are ethyl alcohol (not wood alcohol, but the identical spirit manufactured from grain), turpentine, rosin, pine oil, pine tar, producer-gas, charcoal, acetic acid, methyl alcohol, pine "wool," acetone, oxalic acid and various other chemicals useful in dyeing and cloth printing. The development of all these industries, separately or in conjunction, ultimately will be brought about in the process of making the manufacture of lumber "an incident in the business of lumbering." And, if there is any significance in the impetus recently given commercial ventures along such lines, that transformation is not far distant.

A typical fiber-board mill located in the South



One of the machines in a fiber-board plant

Economic Changes Wrought by the War

By Ludwig W. Schmidt

DURING the last two years and a half approximately 30,000,000 men have been withdrawn from their usual occupations in Europe, either to fight in the field, or to work in occupations foreign to them in time of peace. Their production has not added to the wealth of the nations, but has rather helped to decrease it.

The average producing power of a workman in one of the industrial countries of Europe is estimated to be $1,000. The Russian farmer and the small artisan of the Balkans earn much less than that, but in western Europe there are many men who have been earning considerably more. So the average of $1,000 may possibly be well accepted.

This would mean that Europe during the last two years and a half has lost $75,000,000,000 of its usual production. Such a figure can only be understood when compared with another near to it. The United States Bureau of Census estimates the industrial production of our country for 1914 at $24,000,000,000. Therefore, more than three times the total annual industrial production of the United States has gone to waste in Europe.

During the same time this country has gone through a period of prosperity never equaled. Employment has been excellent. Exports have increased from $2,329,684,025 in the year before the war to $4,272,397,774 during the fiscal year of 1916, while imports have grown from $1,893,925,657 to $2,197,883,510. That we have been busy making the things we used to buy from other countries, is shown by increased imports of raw materials and the decline in the imports of manufactured goods.

During this period, we have increased our industrial output at the rate of $1,000,000,000 a year. America, which considered herself rich when she reached in her foreign trade a credit balance of $470,000,000 in 1914, during the last two years has increased this to $2,100,000,000. To check the unprecedented flow of gold we have lent vast amounts of money to foreign countries which formerly had been the money lenders of the world.

America so far has not noticed any detrimental effects of this unexpected prosperity. The demand for labor has increased and wages have taken a small but determined rise. However, there are signs that changes are coming. A weakening in our imports is already taking place. The movement is still too new to be fully understood, but news received from other countries gives it a rather serious aspect, for the time being, at least.

The world begins to feel the strain of the war An upheaval like that in Europe must affect ultimately the economic structure of the whole world, South America, the Asiatic East, in short, every market of the world has been left without its usual supply of industrial goods. Importers in those markets have earned less, so has the small dealer, so finally the farmer. Crops are short over the whole world. They have not been attended to properly in Europe because the men were away fighting. Fertilizers usually exported by Germany have not been at hand, agricultural machines from England and America were more expensive and therefore in less demand. To produce and to export the farmer needs easy money. But money to-day is employed in the business of war or lies safely guarded in the vaults of the big banks. The farmer could not get the accommodation he needed. In Argentine alone over a million acres less are under cultivation.

But the shortage does not apply only to foodstuffs. Many of our most needed industrial raw materials do not arrive in the former quantities Here a great change in the habits of our national economic life has taken place. We had got so accustomed to buying our raw materials through the help of other nations that we had quite forgotten how to trade in them ourselves. The war, depleting the financial resources of Europe, has forced producers of raw materials to go to America to exchange their goods for money. We no longer buy our copper with the assistance of a foreign combination of merchants, nor do we rely, to give another instance only, on foreign markets for our furs. We now deal in these and many other articles directly. This tendency is not entirely new. The war, however, has brought to a climax a development which had been set going by farseeing American merchants.

It is not so long ago that we were buying in the markets of Europe, large quantities of silk, Asiatic as well as Italian, for shipment to this country. Our manufacturers were willing to rely on the Italian and French merchants for their silk, and the prices of Milan and Lyons were governing our markets also. Arrivals of silk via European markets had already declined several years ago and the war has practically put an end to the whole connection. America now buys her silk direct. In the Japanese and Chinese silk market American buyers now appear as important members of the buying community, and prices possibly are regulated by the demand of America.

The situation is still more pronounced in another field, that of rubber, Before the war approximately one third of our rubber supply came via London. This was not all rubber grown in India and Ceylon; even Brazilian rubber frequently has been sold to us by London holders. England still continues to send us great quantities of india rubber; but where before the war the direct arrivals from the East Indies were a matter of less than $10,000,000, they have grown now to $75,000,000. Again, fur auctions are taking place in America, rivaling those of London and Leipsic.

What does it all mean? It means that the routes of shipments of raw materials in the world's market have undergone great changes. While all roads formerly seemed always to lead to Europe, new and direct ways to the American market have been opened. The producer of raw materials has found it to his advantage to ship his goods here, thus circumventing the European intermediary. It is a question whether this tendency will continue after the war. It lies, however, in the interest of this country that it should continue.

America in former years has sent to Europe great quantities of foodstuffs. Since the outbreak of the war Europe has increased considerably her own output of cereal and other foodstuffs. France, Germany and England have laid out an agricultural policy destined to make their countries less dependent upon foreign supplies. Foodstuffs, however, have played a large part in building up the favorable credit balance of America in Europe. With that credit balance in our hand it did not greatly matter that the European market, as middleman, was earning a profit in selling our raw materials. We could afford to pay a commission to

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The Motor-Driven Commercial Vehicle

Conducted by VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

Standard U. S. Army Ambulance

THE Medical Corps of the U. S. Army has not been neglected in the military preparedness plans of the War Department. This is evidenced by the designing and adoption of a new standard type of army ambulance and the organization of new medical units known as Motor Ambulance Companies. Prior to the complications which called the regular Army and a large number of volunteer militia organizations to the Mexican border, army ambulances were animal drawn. Having observed the speed with which the motor truck industry was mobilized to meet the sudden demands for army transport trucks and knowing from experience that the motor transports have demonstrated their ability without question, the medical department provided for equal promptness in a military emergency by designing a standard ambulance body that can be built by any wagon-body builder and applied to various standard truck chassis. While public attention has centered upon the motor trucks used in troop movements to the Mexican border and the transportation of supplies, a number of special types of vehicles have been designed that the public is not as familiar with and yet these are fully as important as the trucks intended purely for general transportation.

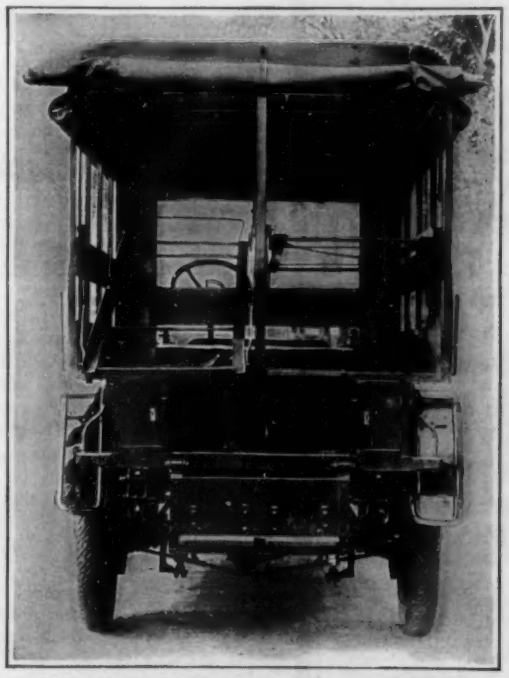
New standard U. S. Army ambulance on a light truck chassis

The plan of organization of the motor ambulance companies and the new body designs were worked out by a special Army board, and 52 vehicles of the type illustrated have recently been placed in service on our southern boundary. These machines have been organized into four companies, each composed of twelve motor ambulances and one three quarter-ton repair truck. The development of the standard body design puts the government in a position where it can order bodies from any reputable body builder and simultaneously order chassis from motor truck manufacturers. This greatly facilitates the work and avoids unnecessary delay. Even though the body type is standardized no restrictions in the matter of up-to-date facilities and methods of transporting wounded soldiers were necessary in the design. The various types of ambulances now in service in Europe were studied before the board evolved the new standard. This has a capacity for eight patients seated inside and an orderly riding in front with the driver. Four patients may be carried on stretchers or litters, the two composing the upper tier are suspended by iron hooks with spiral spring attachment to ease road shocks.

The seats are hinged in such a manner that when they are not occupied by sitting patients, the upholstered side may be turned down, forming a floor on which standard United States army litters may be carried. Compartments for ten one-gallon tins forming a reserve supply of gasoline are provided under the seats and there is also ample room for other supplies. Compartments are placed at each side under the front seat for carrying water tanks. Emergency medicines and surgical dressings are carried in a compartment between the stanchions at the right of the driver's seat. The frames for supporting the litters at the top are hinged in such a way that they may be tilted to make loading and unloading easier. In the rear view of the ambulance one of these frames is shown in normal position, the other tilted down as it would be when placing or removing a patient.

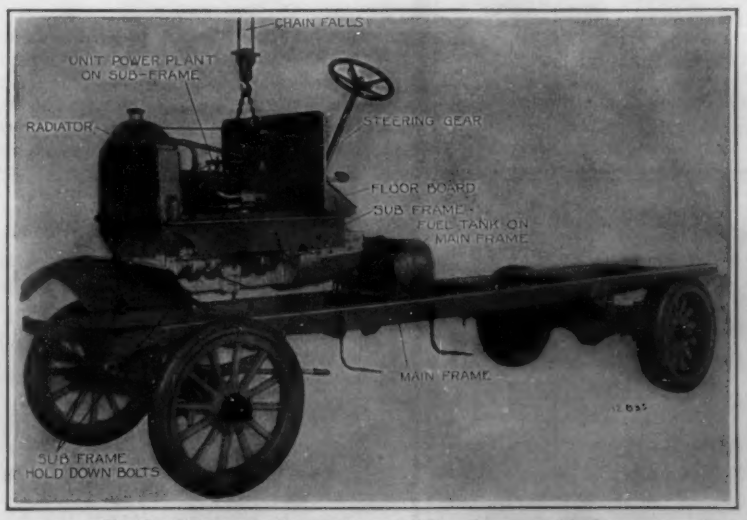
Truck with Removable Power Plant

THE conventional system of truck construction where the power-plant parts are assembled directly in the main frame has the advantage of simplicity of design, but in event of power plant trouble it is usually necessary to lay up the entire truck while repairs are being made on the faulty power plant. Where a large number of trucks are used it is customary to have emergency trucks which are kept in readiness to take the place of any that may be out of order. These trucks are not used except in emergency and while standing idle they represent an investment that could be reduced considerably if they were not needed. The designer of a recently announced worm-drive truck evidently realized this drawback of the conventional construction so he has devised a demountable power plant which can be removed from the truck frame for repairs and a new one substituted in its place. Naturally the investment in power units would be less than that in complete trucks and by having one or two spare power plants on hand it would be possible to keep all the trucks running even should trouble be experienced with several of the engines. The wheels, front and rear axles and springs, which are the remaining truck parts liable to fail in service, are all units that can be easily removed and replaced with spares. This has not been true of the power plant, however.



Arrangement of litter carriers in the ambulance

In this truck the gasoline engine, clutch and transmission form a unit power plant and in connection with the radiator, dash and toe boards, brake and clutch pedals and steering gear are assembled on a sub-frame member or cradle that can be easily mounted in the main frame. By removing six hold-down nuts, disconnecting the drive shaft from the rear of the gear box, the brake rods and the fuel connections, the demountable power plant may be removed and another unit substituted in less than thirty minutes without disturbing the driver's seat or the load carrying portion of the body. The accompanying illustration shows how easily the entire demountable power plant and sub-frame structure can be removed from the main frame. By having the radiator and steering-gear attached to the sub-frame instead of the main frame it is not necessary to disturb any of the controlling elements or the parts of the cooling system when removing the demountable power plant. Another advantage of this construction is that after repairs are made that it is possible to try out the power plant to make sure that it functions properly without replacing it in the main frame. This is an especially valuable feature after an overhauling in which main- and connecting-rod bearings have been refitted, or where new piston rings have been installed. Instead of the driver having a stiff engine to start as is the case when the repaired power plant is installed in the conventional truck frame it will be possible to run the engine in its sub-frame to limber it up before it is sent out on the road.



Truck with power-plant and control in a demountable frame

Suggested Requirements of U. S. Army Trucks

AS a result of the use of many different makes of motor trucks in connection with army work along the Mexican border and in Mexico, army officers have formulated a tentative outline of requirements that experience has demonstrated can be incorporated to advantage in trucks or tractors for military use. The authorities agree that the 4-cylinder engine is entirely suitable, though it must be of more than sufficient power for the normal work, and that the power rating should be based upon its real performance and not merely on a high theoretical rating. It is stated that anything less than a 4-cylinder motor of 4¼-inch bore and at least 5-inch stroke should not be considered applied to a truck rated at two tons. For hauling a section of field artillery a 50 horse-power engine will be suitable for a tractor power plant. The officers at the Rock Island Arsenal believe that the most promising tractor for hauling heavy field artillery is the type employing the track-laying principle because of the great surface over which the load is distributed and the resulting traction secured by the use of the caterpillar tread. The carburetor should be set high enough to prevent water from entering it in crossing large streams and adjustments and connections should be readily accessible without removing other parts. The gasoline tank should have a capacity for at least twenty-four hours running. Connections should be exposed so that leaks will be easily noticed and quickly corrected. The tank should be provided with drain cock and strainers in the fuel line. The shape of the tank should be such that practically all of the gasoline can be drawn from the tank irrespective of the longitudinal or cross-wise inclination of the truck. A small reserve supply of fuel that cannot be used without being turned on by the driver should always be carried. The best way to provide this is by partitioning the tank so that a certain amount will be trapped and will be used only when a three-way cock is turned after the main tank has been emptied.

In regard to the radiator it is conceded that the tubular type is preferable to the cellular construction. The radiator should be mounted on suitable springs or buffers. Drain cocks should be provided to draw off the water quickly. The efficiency of the cooling system should be tested by running at least ten miles over an unfavorable highway surface that will call for considerable use of the low gears. A radiator which boils water on each short stretch of poor road will cause endless trouble and will not be suitable for military purposes. The cooling pump should be

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Suggested Requirements of U. S. Army Trucks

(*Concluded from page 179*)

driven by a small key, spring connection or other easily replaced part that will break in preference to the pump in event of the water's freezing or of stoppage due to sediment. Ignition should be by magneto of the high tension waterproof type which should be mounted high enough to clear water when fording streams. An impulse attachment is desirable as this will enable the magneto to produce a satisfactory spark without spinning the engine. The lubrication system should include a sight feed of some kind so the driver will be apprised at once of any failure of the oil supply. An easily read engine gauge should be provided to show how much oil is available in the reservior. Grease cups and oil plugs that are not in plain sight and easily reached are objectionable.

The brakes should be powerful enough to hold the loaded machine on a 20 per cent grade without any trouble. A four speed sliding gear transmission with exceptionally wide-faced gears and any make of standard clutch that can be easily inspected and adjusted will prove satisfactory. Good road clearance is essential and if the clearance is low it is desirable that some strong part such as an axle be first to strike the obstruction rather than some relatively delicate part, such as a steering rod or sod pan. In addition to the tools usually furnished to make all field repairs the outfit should include an exceptionally strong jack, heavy sledge hammer and two crow-bars. While electric lighting has proven to be very dependable it is desirable to include an auxiliary system of kerosene lamps so that these may be used should the electrical group fail under service conditions.

The recent appropriation by Congress of several millions of dollars for the purchase of motor trucks was undoubtedly determined by a careful study of relative cost with animal-drawn equipment. The figures are fortunately very favorable to motor transport. It has been stated that a large saving can be made if motors are used instead of horses. The field artillery board estimates a saving of about $40,000 if a battery of 6-inch howitzers is provided with motor transportation. If six caissons are replaced by trucks there will be another saving of $23,000 in addition to $11,000 for harness and $2,000 for personal and horse equipment, this bringing the total gross saving to about $75,000. The automobile stores and battery wagons will cost as much as at present so no saving is estimated. To replace the horses needed in drawing the field pieces and caissons, five tractors at about $3,500 each and six trucks at about $2,500 each, making a total of $32,500 for motive power. Twenty per cent of this figure should be added for extra equipment, spare parts, etc., which brings the cost to $40,000, and makes a net saving in initial cost of $35,000 per battery. It is believed that the saving in Ordnance Department material alone would be sufficiently great to provide practically complete motor transport for militia batteries and thus satisfactorily solve the problem of transportation, which is understood to have been the main barrier to the organization of heavy field batteries for the militia and to have kept the great part of our small stock of heavy material locked up in arsenals and armories.

Potash from Sand-Hill Lakes

(*Concluded from page 167*)

The process at the evaporating plant consists in boiling down the briny water until the salts crystallize out. For the main part of the work three huge vacuum kettles are used, each one of them being about eighteen feet high and seven feet in diameter. When the liquid has been through the boiling process it is yellowish in color. Before all of the equipment for the evaporating plant had arrived it was the custom to sell the product in this liquid stage, shipping it in tank cars to the eastern market. When the plant was completed this was done away with, since transportation costs were somewhat prohibitive. The reduction is now completed in centrifugal driers, the liquor being brought down to crystals much as is done in a sugar factory. When the process is finished a grayish mass of crystals results and it is in this form that the product is now marketed. No effort has been made so far to separate the soda and potash salts, this being carried on in the east.

An approximate idea of the content of these crystals may be had from a representative analysis which showed water 2.1 per cent, potassium oxide (K_2O) 27.4 per cent, sodium oxide (Na_2O) 28.4 per cent, carbon dioxide (CO_2) 22.4 per cent, sulphur trioxide (SO_3) 16.8 per cent, free chlorine 2 per cent, unspecified impurities .9 per cent. Another lot, when made completely anhydrous, showed 32.5 per cent of the potassium and 23.9 per cent of the sodium salt, 32.2 per cent of the sulphur trioxide, 10.9 per cent of the CO_2, and .5 per cent free chlorine, with only .2 per cent of other substances.

The pioneer concern in the work is now shipping about fifteen hundred tons of salts a month from Hoffland. The other companies are newer in the field and no figures have been made public as to the exact results of their work. The above analysis show that the necessary elements for the manufacture of potassium carbonate are present in the Nebraska product, and this is a great advantage. It appears that Nebraska is practically the only State able to produce potassium in this form. Moreover, there is a good profit on the sodium and sulphur compounds, so that the net financial result of the whole operation is most satisfactory. By some of those connected with the Nebraska industry it is estimated that half of our potash supply now comes from this source. While we should be inclined to place the figure a bit lower, the vital importance of Nebraska potash cannot be gainsaid.

Some years ago a mining authority visited the lakes. He looked over the ground. "The proposition is not worth while," he declared. "It will take too much money to get the potash out of the lakes." All of which proves that there is a way around nearly all obstacles, although it is true that had the war not intervened to advance the price of potash probably no one would have had the courage to develop the industry in Nebraska.

How successful the operations will finally prove naturally depends on the amount of potash in the respective lakes, the market price of the product and the length of time the supply will hold out. When the operations on Jesse Lake were begun it was estimated that there were 250,000 tons of salts in the lake. This means that the supply will not hold out indefinitely. In fact it will be impossible to extract all of the 250,000 tons from the lake; for there will, of course, come a time when the results will not justify carrying on further work.

In case importation of potash salts from Germany is resumed in the next few years Nebraska companies will succeed in proportion as they are able to compete with the foreign product. As long as the war lasts, however, Nebraska producers are quite sure of success and those already firmly established will probably find themselves in a good way to compete with foreign markets.

Our Tropical Storms

HURRICANES may form anywhere over the region of the doldrums, which, at the season of the year when these disturbances are of most frequent occurrence, cover a belt in width ten degrees of latitude or more and extending from the Gulf of Mexico eastward to the African coast. They have been known to form in that part of this belt near the Cape Verde Islands, passing thence westward to the Lesser Antilles. But those that affect our Gulf and South Atlantic coasts are usually first observed immediately east of the Lesser Antilles or over the Caribbean Sea; an occasional disturbance of this character has even originated over the Gulf of Mexico.

The forces that operate to form a hurri-

(*Concluded on page 183*)

RECENTLY PATENTED INVENTIONS

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Pertaining to Apparel

COMBINED BATHING CAP AND SUIT BAG.—J. ZUCKERMAN, Waterproof Novelty Co., 50 W. 22d St., New York, N. Y. An object of the invention is the provision of a construction which may be folded in one position so as to act as a cap, in another position to act as a bathing suit bag, and a third position to act as a jacket for an inflatable member so that the jacket and inflatable member will produce a ball.

ARCH AND ANKLE SUPPORT.—H. A. BERNSTEIN, 139 W. 119th St., New York, N. Y. In carrying out the invention use is made of an endless elastic band twisted to form an arch loop and an ankle loop, the loops standing approximately at a right angle one to the other, the portion of the band intermediate the loops having their opposite flat surfaces slidingly overlying one the other.

OFFICE COAT.—N. INGER, 314 Columbia St., New York, N. Y. The present invention obviates defects in office coats heretofore in use, that is to say, first, it reinforces the sleeves without materially affecting the weight and cost of the coat, second, it protects the pocket sections of the coat against tearing, and third, it provides the arm-hole portions thereof with means which increase the durability of the same and serve also as sweat shields.

RETAINING DEVICE FOR UMBRELLA RIBS.—W. G. SCHEINPFLUG, care of Fred Cosmer, 503 W. 124th St., New York, N. Y. The invention provides a retaining or closing device which can be readily carried in a vest pocket when not in use, and is particularly designed for holding the ribs tightly around the stick of an umbrella thus preventing the tips from catching on doors, garments or other objects in or along the path of a person carrying a folded umbrella.

Pertaining to Aviation

HYDROAEROPLANE.—L. P. PEREW, North Tonawanda, N. Y. The flying machine is so constructed that the balancing and stabilizing thereof may be effected without the employment of stabilizing elements additional to the main planes. This object is effected by a transverse shifting of the planes and their frame structure, to displace the mass represented thereby, and variously dispose the same relatively to the mass of the main body of the machine and various positions, relatively to the longitudinal center of the machine, the total surface presented by said planes and frame structure.

AUTOMATIC APPARATUS FOR AERIAL PHOTOGRAPHY.—A. B. BARON, 155 Boulevard de Magenta, and C. M. A. GUINARD, 8 Avenue de l' Opéra, Paris, France. The apparatus is adapted to be secured under the car of a dirigible balloon, or the frame of an aeroplane. It is essentially characterized by the combination of an optical dark camera inclosed in a box—of a motor automatically insuring the unwinding of the film—and of a shutter controlled by the motor so as to be released at the precise moment when the film stops in front of the objective.

Electrical Devices

INDICATOR SYSTEM.—A. ZEISEL, care of Zeisel Electric Co., Bel Air, Md. The invention is applicable as an engine telegraph for steam boats; for hydro-electric plants; as water level indicator in dams, reservoirs and tail races; indicator for water wheels; indicator of water levels in stand pipes and reservoirs; to indicate the quantity of gas in gas tanks, and to automatically inform one of the quantity of liquids in tanks at distilleries and breweries.

INSULATOR.—F. C. PIERCE, Filer, Idaho. This invention has for its general objects to improve the construction of a device so as to be reliable and efficient in use, comparatively simple and inexpensive to manufacture, and so designed that the stringing of a wire is greatly facilitated and expedited.

SHIP CLEANING DEVICE.—P. GANS, Route 5, Box 207, Des Moines, Iowa. The specific object of the invention is the provision of a combined electromagnet and roller for maintaining a powerful running contact with the magnetic surface, the roller being so designed that it can be oppositely driven by suitable mechanism, and the magnetic force will be always operative to maintain the roller in attractive contact with the surface to be cleaned.

Of Interest to Farmers

CHICKEN FEEDER.—E. W. DANA, address, W. J. Boll, Platteville, Wis. This invention provides means to protect the feed in the pans until the latter are released; provides a chicken feeder of this class and its controlling means, simple in construction and reliable in operation which may be employed in connection with an ordinary clock movement to effect release of the pans.

SCAFFOLD.—G. W. WALKER and E. H. HARBY. Address the former 15th Block, N. Church St., Gibson City, Ill. An object here is to facilitate the erection of silos and similar structures by providing a scaffold which may be readily assembled and which includes a working platform vertically adjustable in a novel manner and effectively supported in its adjusted positions.

GROOVE CLEANER FOR ROLLING MILLS.—F. SCHERR, Jr., and B. P. LUCE. Address the former care of Pioneer Iron Works, Pioneer St., Brooklyn, N. Y. The invention relates to groove cleaners for the grooved rolls of a rolling mill, and is primarily intended as a cleaner for the grooves of the rolls of a sugar-cane mill. To obviate the defects of former cleaners the invention provides a cleaner which is simple, easily installed, interchangeable and easily and quickly adjusted for any slight variation that may occur in the distance between the grooves of the various rolls.

INCUBATOR BROODER.—C. H. SPERLE, R. F. D., No. 1, Bound Brook, N. J. This invention relates to combined incubators and brooders and an object is to provide a construction whereby the eggs are provided with a free circulation of air without a draft and are rolled over while in contact with the heating medium and a support for imitating the action of the rolling egg in a natural nest.

HULLING MACHINE.—C. SCHAFLER, 21 Macon St., Brooklyn, N. Y. The object in this case is to provide a hulling machine more especially designed for hulling cereals such as maize or Indian corn without danger of breaking or crushing the grains, thus rendering the hulled grains especially serviceable for the making of tortilla or arepa.

GATE OPERATOR.—C. REMHARE, 4189 17th St., San Francisco, Cal. Objects of this invention are to provide a gate improved in various particulars with respect to its latching means, and with respect to counterbalancing the gate for its easy operation, whereby the opening and closing will be positively effected and with facility.

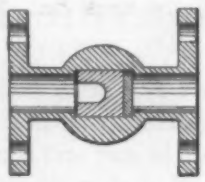
CHICKEN PERCH.—H. G. BRAHMAN, Box 94, Reading, Mich. In the present patent the invention has reference to the care of poultry, and the main object thereof is to provide a thoroughly sanitary and vermin-proof perch and a floor thereunder for the reception of droppings which may be angularly tilted for cleaning.

AGRICULTURAL IMPLEMENT.—C. E. SACKETT, 15 Terrace Place, Danbury, Conn. The improvement relates especially to such agricultural implements as are intended to plow, pulverize, fertilize, and seed the land in one passage over it, and provides a fully prepared seedbed in one operation, and avoids the trampling or packing of the seed-bed in whole or in part.

HARROW EVENER.—W. H. JONES, Nelson, Cal. This invention provides an evener of a large size, and adapted to make a swath of considerable width—say 80 or 100 feet—the parts being so arranged that they may be taken apart to some extent and reassembled, so that the device may be readily transported after the manner of a vehicle, from one point to another.

Of General Interest

TEST PLUG.—R. S. BENSON, West Paris, Maine. In the present patent the invention has reference to pipe lines of various kinds and classes, and the main object thereof is the provision of means installed at various points in such a line, or in sections thereof, for facilitating the cleaning of such lines, testing for leaks, and the like.



TEST PLUG

ENVELOPE.—F. L. TOUPAL, Chicago Heights, Ill. In this instance the invention provides an envelope having an open end and two transverse slots adjacent thereto, so that a tongue extending from the flap at the open end may extend down through one slot and up through the other, for locking purposes.

METHOD OF EXTRACTING AND MODIFYING PROTEINS OR ALBUMINOUS MATTER.—C. C. RINGLER AND J. BEERHALTER, Address the former, care of Fitger Brewing Company, Duluth, Minn. In this instance the invention has reference to a method of extracting and modifying protein or albuminous matter from substances containing it, and is particularly adaptable to the extraction and modification of protein or albuminous matter from yeast cells.

ENVELOPE.—C. A. CHESTERTON, care of Union Bank of Canada, Somerset, Manitoba, Canada. This invention has particular reference to a useful form of inclosure or envelope for letters or the like. It is intended primarily for first-class mail matter. The invention provides an envelope that is adapted to be sealed or secured by a riveting or stapling machine without gumming the sealing flap.

ASH TRAY AND CIGAR REST.—E. OLDENBUSCH, 388 Butler St., Brooklyn, N. Y. This improvement relates to ash trays and supports for cigars, and has for an object the provision of a simple arrangement whereby the ashes from a cigar may be readily dropped into a preliminary receptacle as the cigar is supported on the rest.

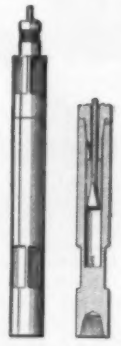
HORSESHOE.—D. S. ANTHONY, 413 5th Ave., Sioux City, Iowa. This invention improves and simplifies the construction of calk attached horseshoes so as to be reliable and efficient in use, comparatively simple and inexpensive to manufacture, and so designed that the calks can be easily and quickly attached without the need of any special instruments.

THERAPEUTIC APPARATUS.—H. B. PHILIPS, Gouverneur Hospital, New York, N. Y. This invention combines with the trocar an element in the nature of a curette adapted to be introduced into or through the cannula for the purpose of removing any obstructions that may interfere with the proper flow outwardly through the cannula or outlet. It provides locking means to retain either or both of the trocar or curette elements in position in the outer end of the cannula and thereby render said outlet end of the cannula practically air tight.

Hardware and Tools

IMPLEMENT.—E. KINZEL, 468 Elk St., Albany, N. Y. This invention provides an implement such as a shovel, spade or the like, arranged to permit of quickly and securely assembling and fastening together the handle and blade without the use of special tools, or to disassemble the parts with a view to form the same into a small bundle for convenient carrying in a knapsack, bag, grip or other receptacle.

SWIVEL SOCKET FOR OIL AND GAS WELL DRILLS.—J. H. KUHNS, 630 N. Cheyenne St., Tusla, Okla. The invention provides a swivel joint on which hardened shoulders are provided against which the swivel collar to which the lower end of the cable is connected may bear, so that a strong, long-wearing construction is provided. It provides a swivel joint in the nature of detachably connected barrel sections, through which the cable extends, and in which a swivel collar is adapted to play, said collar being connected to the lower end of the cable, so that the collar will not bind against any of the parts of the device.



SWIVEL SOCKET FOR OIL AND GAS WELL DRILLS

Heating and Lighting

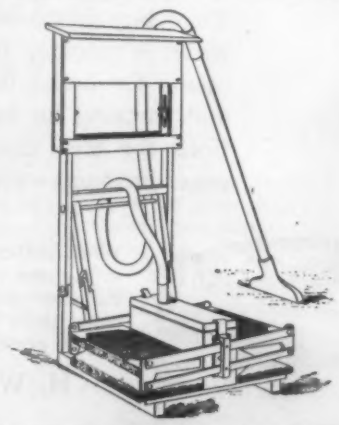
COMBUSTION ACCELERATOR.—E. A. HELLER, 713 Tilton Ave., Bronx, N. Y. This invention relates to means for accelerating the combustion of fuel in furnaces, and has reference more particularly to a device for facilitating the consumption of smoke which would be otherwise unconsumed. The accelerator is placed sufficently above the grate not to interfere with the charging of the grate with fuel.

SEARCHLIGHT.—J. H. MCPARTLAND, 19 Water St., Houlton, Me. This invention refers more particularly to a searchlight adapted for use on a locomotive or on shipboard and mounted for directing the light at various angles to indicate the direction of travel, as well as to illuminate the track or course ahead of or behind the train or marine vessel.

Household Utilities

SLEEPING BALCONY.—H. M. COE, 26 Colfax St., San Jose, Cal. This invention provides a structure whereby a balcony may be roofed over in a thoroughly weatherproof manner to make the balcony a part of an adjacent room, or whereby the balcony may be rendered roofless and the adjacent room be rendered thoroughly weatherproof, thereby permitting use of the balcony in fair or inclement weather.

PUMPING MECHANISM FOR VACUUM CLEANERS.—A. J. FAUCHER, 402 Pine Street, Wichita, Kan. The vacuum cleaner is operated in a stationary position and connected by a flexible hose with a suction nozzle, which is adapted to be moved about over the surface or surfaces to be cleaned. Means provide manually operated pneumatics so arranged as to enable the same to be operated with a minimum effort on the part of the operator, and provide a seat structure for the operator which may be folded into a small compass when the apparatus is not in use.

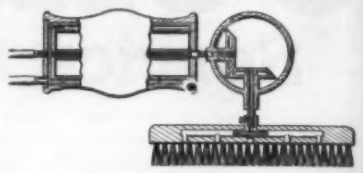


PUMPING MECHANISM FOR VACUUM CLEANERS

Machines and Mechanical Devices

MAGAZINE CAMERA.—J. P. HANSEN, No. 9 Aarhusgade, Copenhagen, Denmark. The invention permits of a direct focusing on the ground glass, even to the fraction of a second before the exposure, as the plates are placed under the top of the camera in such a manner that the turning of a handle swings the plate down in a vertical direction to be swung farther in the opposite horizontal direction in the bottom of the camera after the exposure is completed.

SELF-MOISTENING AND SELF-SOAPING BRUSH.—S. LIGHT and W. EICHELBERGER, Address the former, Pierce, W. Va. The invention provides a brush and a water motor so connected that the motor will rotate the brush on its central axis and wherein mechanism is provided in connection with the connection between the brush and the motor for grinding the soap, and wherein other mechanism connected with the motor is provided for moistening the soap and discharging the ground wet soap into the bristles of the brush.



SELF-MOISTENING AND SELF-SOAPING BRUSH

Medical Devices

VACCINATING DEVICE.—T. A. FLOOD, 516 Boston Bldg., Salt Lake City, Utah. The invention provides a shield to be placed upon the skin and worn over the vaccinated area, primarily to prevent the applied vaccine virus or lymph from being rubbed off, by coming in contact with the clothing or otherwise, and secondly, to minimize the danger of bacterial infection immediately following the vaccination or at any time subsequently thereto. The mechanical device greatly simplifies and expedites the operation, and minimizes the pain, discomfort and inconvenience usually incident thereto.

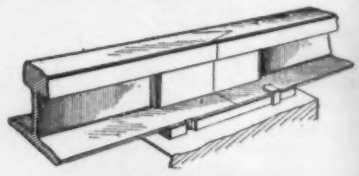
VACCINATING DEVICE

Prime Movers and their Accessories

EXPLOSION ENGINE.—M. S. DARLING, Conrad, Mont. The invention accumulates a supply of gas mixture, after explosion thereof, and stores the same, under pressure, until utilized as a motive power to operate other mechanism. In carrying this out, the invention provides a sectional stator in which is mounted a motor operated by the explosion of the mixture, said stator having secured thereto a tank which communicates with the explosion chambers through a suitable valve-controlled port.

Railways and Their Accessories

RAIL JOINT.—M. F. RADOVAN, Kennecott, Alaska. This invention relates to improvements in constructions for joining the meeting ends of rails. One of the objects of the invention is to dispense with the use of fish plates, bolts and nuts, by providing a rail chair supported upon a tie and adapted to receive therein the meeting ends of the rails which are effectually secured to the chair and the latter to the tie, in a single operation by the means of spikes.



RAIL JOINT

Pertaining to Recreation

DOLL.—AMELIA MORSE, care of Rite Specialty Co., 35 W. 36th St., New York, N. Y. The invention relates to games and toys and has particular reference to figure toys, such as dolls. It provides a construction of doll having a lighter and stronger construction than other moderate priced dolls heretofore proposed.

Pertaining to Vehicles

FOOT SCRAPER AND CLEANER FOR AUTOMOBILE RUNNING BOARDS.—W. A. ROOS, 109 W. 225th St., New York, N. Y. The invention improves and simplifies the construction of foot-cleaning devices, so as to be reliable and efficient in use, and so designed that it can be used as an attachment for cars already in use, or can be built into the car body.

FAN BELT ADJUSTMENT.—E. C. LANE, address N. Y. Motor Car Device Co., 200 11th Ave., New York, N. Y. Among the objects of the invention is to provide a fan belt adjustment for a standard type of automobile, the mechanism comprising a rigid support in the nature of a block screw having a head formed in a peculiar manner to adapt itself for the other parts of the adjustment device.

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Our Tropical Storms

(Concluded from page 180)

cane are not definitely known. We do know, however, that the region where they are formed is one of relatively low pressure, and flanked by oppositely directed winds—on the north the northeast trades, and on the south the southeast trades, which on crossing the equator are deflected and become southwesterly winds. Conditions of moisture and heat unquestionably are responsible in some way for the intense character of the hurricane.

Various propositions have been made looking to the artificial restraint of these storms. But once a hurricane is initiated, the prevention, by artificial means, of its intensification, or the dispelling of these violent whirlwinds when once well formed, is beyond human agencies. In the first place they usually originate over large water areas where anything in the nature of artificial barricades is in the very nature of things impracticable; and in the second place their vertical axis is probably one of several miles, so that no obstacle which might be interposed in their path, however scientifically constructed, could do more than bite a very insignificant slice off the lower tip, leaving the main body of the hurricane in undiminished fury.

French Supplies of Reconstruction Materials

THE French Minister of the Interior has just published the results of an investigation made under his direction concerning the supplies of building materials likely to be available for reconstruction work in France upon the conclusion of peace. Among the materials thought to be available in sufficient quantities are stone, brick, sand, cement, tile, building hardware, wall paper and certain others of minor importance. It is believed that for lime, iron pipe, street-paving materials and sandstone, French production may be increased to a point that will meet the demands. In the groups of materials in which a shortage may be felt are plaster, timber and lumber, slate, structural iron and steel, heavy hardware, tin, zinc, lead plumbing supplies, pumps, sanitary appliances, heating apparatus, paint and glass of all sorts.

It is reported by the government that the necessary steps will be taken promptly to encourage the larger production of those materials of which there will undoubtedly be a very considerable need as soon as building operations are resumed on a large scale. These measures consist mainly of: The provision of facilities for obtaining the necessary equipment for producing building material; the resumption of operations in plants that were shut down; the resumption of the exploitation of mines and quarries; the reopening and improvement equipment of brickyards, tile works, and establishments engaged in the manufacture of lime and cement and other basic building materials; finally the adoption of measures to increase the available supply of labor. It is, furthermore, stated by the French government that every effort will be made to have the work of reconstruction undertaken as far as possible by local concerns. It is of course generally understood that the government will give financial assistance to all manner of reconstruction work in the devastated regions of France.

Tristan da Cunha

THIS little island, or rather group of three islands, only one of which is inhabited, lying about midway between Cape Town and Buenos Aires in the South Atlantic Ocean, is of perennial interest on account of its excessive isolation. Communication of any kind with the rest of the world is a rare event. The population is about one hundred, and there is no government, though the place is a British possession. A letter to the London *Times* records a recent visit by a British steamer. The islanders were found to be in considerable need of food and clothing. They possess only two frail canvas boats, and would consider a good whale-boat or surf-boat a great boon. Education is almost entirely neglected.

Economic Changes Wrought by the War

(Concluded from page 178)

London or Hamburg on our rubber, our Argentine hides, our Chinese rice. Those markets were large customers of ours, and they were willing to do our work to repay us for our foodstuffs.

If, after the war, however, they should not take so large a quantity of our foodstuffs, if they should confine themselves to buying only our industrial raw materials, this will give us cause for concern. We might ask ourselves why an American house should not earn that profit of the middleman. Every pound of silk imported direct from Japan and China brings a profit to an American importer. So it is with the hides we receive direct from China and South America; so will it be the case with rubber and many other raw materials. Buying direct from the markets which actually produce the goods brings the profit of their sale into our own pockets. We will then be better able to stand a possible falling off in the exports of our foodstuffs.

But direct buying presents other apects. If we buy direct we shall also have to pay direct. In former years a large part of our foreign payments were made via London and Hamburg. In this way we used up our credit balance in Europe. When this credit balance gets smaller we shall find that in settling for our raw material supply in non-European markets we must pay by our own check. The movement has already begun. Our gold remittances to South America, which during the year 1914 were only $497,400, have grown to $10,001,538. The change in the whole direction of our Eastern Asiatic trade will be understood when we see that while in 1914 the total gold payments to Asia were only $6,515, they have reached during 1916 for India, China and Hongkong alone well over $12,000,000, in addition to which we paid more than $7,000,000 to Asia in silver.

If we buy direct from these countries they will also enter into direct communication with us. We have seen an increase in orders for American merchandise from many markets to which we formerly sold but little. To be sure, many of the world's markets cannot get their merchandise in Europe and therefore must come to us. But it is a recognized maxim of foreign trade and trade in general, that he who buys also can expect the custom of him from whom he bought. Gold shipments in themselves are only a sort of payment. The foreign merchant cannot do anything with gold. It does not sell with a profit, it simply pays. What he wants is merchandise to sell, which will enable him to make a profit both ways. Europe pays the largest part of her indebtedness in merchandise. So shall we do and so we are already doing in an increasing manner. And this payment in industrial products will add to our own wealth, because we earn more on these than on raw materials and foodstuffs.

The economic period of before the war is the period of yesterday, and like yesterday, it will never return. America by entering the world's market as a principal, selling and buying direct, has ranked herself economically with the European industrial nations. What will Europe have to say to this new America? Will she carry our goods in future as willingly as in the past, or shall we have to do our own carrying in American bottoms? Carrying in the world's market means more than owning a merchant marine. It entails the control of foreign shipping. It requires means for shipping to our own shores. We want an exchange, where forwarding men and shipping owners can meet. Space will have to be dealt with as in London. It is not a mere coincidence that shipments of many raw materials formerly were directed to London before they came to us. The carrying of our crops to Europe necessitated the supply of large bulk shipping from our ports to Europe, for which normally no return freight could be found. It was therefore often more convenient to direct shipments from other countries first to a European port and there to reload them into ships which otherwise would have had to return empty to America.

Under the new dispensation we shall receive our imported raw materials, say from the Asiatic East, by way of the Pacific and the Panama Canal. The unloaded ship will then take American raw materials and foodstuffs to its next destination, probably Europe, where it also will unload and carry European goods to Asia. There it will start again for our shores, having had at every stage full shipments. A return line would have to go via the Atlantic to the United States with European industrial merchandise, take our goods to the East, and close the circle in Europe.

This example is not taken from Utopia. The experiment has been carried out by Japanese ships during recent years with a success made possible by the entrance of America into the inner ring of international merchant nations. And if we cannot or will not do the carrying, we may be sure that Japan, equally concerned with us in the new order of things, will.

It will be a different America emanating from the ruins of the European war than that which worried during the month of September, 1914, how she could pay her debts to Europe.

What Was To Be Seen at the First Pan-American Aeronautics Exposition

LIKE nothing else the first Pan-American Aeronautics Exposition, held in the Grand Central Palace, New York city, during February 8th to 15th, has served to show in a striking way the close alliance that exists between the aeronautic and automobile worlds. The exhibits, particular those of engine builders, impressed one with the fact that the two industries have helped one another attain present-day perfection.

Naturally a large part of the exposition was given over to engine exhibits, for after all the engine plays the predominant role in aviation. There were to be seen the highly commendable offerings of several automobile manufacturers who have spent hundreds of thousands of dollars in experimenting with aeronautic engines, as well as representative types of the European engines. Complete aeroplanes were also on exhibition—graphic proofs of the high state of perfection attained in the products of American constructors. Then, too, were the accessories without which no aeroplane can be said to be complete, again bringing to mind the "completely equipped" automobile which is never complete, according to our friends the accessories manufacturers. But the fact remains that among the aeronautic accessories there were numerous devices that not only make the work of the aviator considerably easier, but safeguard him to a greater or less degree.

The exposition was undoubtedly intensely interesting to all classes of people, owing to the extensive use of aeroplanes in the European war, as well as the unsettled condition in which American international relations find themselves presently. Particular interest was attached to the elaborate exhibits of the U. S. Navy and Army, together with the practical displays and demonstrations made by the War Department, the Army, the Navy, the Signal Corps, the Aviation Corps, the Bureau of Standards, the Weather Bureau, the Geodetic Survey, etc., affording every one the opportunity of seeing our Government in preparedness operation. All told, more than one hundred exhibitors entered the exposition, so that everything aeronautical was to be found there.

Jacketed Shrapnel

PLAIN ordinary shrapnel is merely a lot of round, half-inch lead balls loaded into a shell just as shot is loaded into a shotgun barrel. When the propelling charge in the shell is ignited by the time fuse, the little round lead bullets are kicked out with the velocity of 200 feet a second, about the speed of a well-thrown baseball. This, however, is in addition to the speed the shell itself had, and the total speed of the bullets is ample to drive

them into a human body. Despite the loud noise of the high explosive shell, and the fuss made about them and their big guns, the most fatal projectile on the fighting fronts is the shrapnel, the sudden muffled bang overhead, and the fatal shower of 250 round bullets that sprays the ground for yards and yards around.

The weakness of the shrapnel is the fact that it is easily stopped, being only lead, and traveling at no great speed. The French and British helmets stop it; the new French cuirass for the body stops it; any light protection on the trench or the motor car halts the soft lead bullets.

Now comes a Canadian with an improvement on the old form of shrapnel, a jacket of tough metal like that on the army bullets, either steel or copper-nickel, hard and tough, and crimped around the lead ball after it is formed.

This is a horse of another color. The jacketed leaden sphere no longer flattens out at the least provocation, its tough jacket holds it in shape and eanables it to penetrate much more into protective substances. Probably the general adoption of armored or jacketed shrapnel bullets would cut down the usefulness of the now common shrapnel helmets—and so is written another step in the interesting race between armor and projectile that has been transferred from the battleship to land fighting. With the Germans using supplementary armor on their helmets for trench fighting, and using trench masks that cover the whole head and stop even rifle bullets, with the French using a cuirass that is being sold commercially in England as well, the jacketed shrapnel bullet and the new American armor-piercer bullet that gets through an inch of steel merely put armor back a lap in the race.

Completion of Murman Railway in Russia

ACCORDING to an article published by the Russian Chamber of Commerce in Paris, the Murman Railway has been completed and the first trains have been run to the Murman Coast. The length of the line from Petrograd to Alexandroosk is about 930 miles. The road follows the main line Petrograd-Vyatka-Perm to the station Zvanka, seventy-five miles east of Petrograd. There it turns north, passing Petrozavodsk on Lake Onega; Soroka, a small port on the western coast of the White Sea; and Kem, another small White Sea port, about thirty miles farther north. Turning to the northwest, the line reaches Kandalaksha, at the most westerly point of the White Sea, and leaving on the west Lake Tmandra and the small Lake Kola, whence issues the Kola River, a branch of the Touloma, it arrives at Kola, which is situated at the confluence of the two rivers. The railroad then follows the western shore of the estuary to Alexandrovsk, in Katherine Harbor.

New Sources of Common Salt

THE *Journal of Industrial and Engineering Chemistry* of the American Chemical Society gives a full and interesting report of the work of the Bureau of Chemistry of the United States government in connection with the salt industry. There is a great deal of salt—in places. Michigan claims to be able to supply the whole world for 2,000 years with all the salt it needs. New York State claims that it, too, can supply the world, but so far as we know no time limit has been set. Ohio and West Virginia are also large producers, and as in other states the quality is more or less pure according to the particular brine from which it is taken.

No salt is wholly pure, but some few brines contain barium chloride, and this has what might be called the disadvantage of being a poison. In 1913 a number of dairy cows in Cincinnati died from effects that were attributed to their salt ration. Then followed the marketing of what was known as off-grade salt, generally labeled "Not for food purposes" and which was sold to tanneries for use in salting hides; also for glazing pottery and making ice—but it contained a little too much barium to be safe to keep around. When a horse

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New Sources of Common Salt

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or an ox takes his salt, he takes enough to last him for some time and if there is barium chloride in it he may get just a little too much of it.

The Messrs. Skinner and Baughman of the Bureau of Chemistry tackled the problem. They found that by adding a solution of just the right amount of sulphate of soda, the barium, being changed to sulphate, is easily filtered off, and with it is removed the pink or brownish color due to iron salts. Thus there is made available an unlimited supply of salt, which means more raw material for our chemical industries.

Our Eagle Learns to Fly

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and the Sperry double fin angle of incidence indicator; metallized propellers; radium luminous compound for dials; Brock aeroplane camera.

TESTS SUSPENDED: Barlow return action bombs; Barlow aerial torpedoes; Frankfort Arsenal demolition bomb; Capt. Ragsdale's bomb-dropping device; Payne Fire Works Company day and night signals; Consolidated Fire Works Company day and night signals; De Forest Radio telephone and telegraph set; Sperry radio set; Simon Aerofan wireless generator; gyroscopic motion picture camera; Dictaphone for aeroplane work; Mottlau ground speed indicator; underhood type Klaxon horn; Ideal Wheel Company's aeroplane wheels; metal propellers.

TESTS CONTEMPLATED: The special large sized Klaxon horn with a special sensitive sound director; Danielson angle of incidence indicator; Sperry clinometer; Foxboro transmission thermometer; Draeger oxygen breathing apparatus for altitude work; Sperry target sighter. Experiments are to be conducted under the direction of Prof. Alexander Klemin, M. I. T.

In addition to these tests, which indicate that Uncle Sam wants and is going to provide himself with the very best there is in the way of aeronautic equipment, numerous tests of aeroplanes on Government order have been conducted at the station, including supervision of high and low speed tests and climbing tests which were required by Government specifications on the order in question.

At the present time, a photographic map is being made of the vicinity of Mineola, the work being carried on with two automatic aeroplane cameras devised by Arthur Brock of Philadelphia. These cameras are part of an order for an air squadron in the Philippines, and it is both for the purpose of subjecting them to thorough test and for the purpose of making this the first photographic map to be made in this country, that these instruments have been sent to the Mineola station. A new type of automatic aeroplane camera will shortly make its appearance, and it is intended, with both these types, to push through the work of making an aeroplane map along the lines of the present automobile maps, with the greatest rapidity. The first section to be treated will be the immediate area of Long Island. It is intended, for example, to photograph the outlines of forests and towns, and reproduce them on the map so far as their shape is concerned, by which the aviator will experience less difficulty than has hitherto been encountered in flying cross country by the map. Certain details of the French aeroplane maps have been learned, and it is intended to incorporate them as far as practicable in a map of Long Island for aviation use.

Another problem which is to be given immediate attention is that of night flying. The importance of this work is conceded, but it has been found impracticable in the past to devote the necessary energy in conducting the needed experiments. The station is now equipped with a 36-inch searchlight, twelve flood-lighting projectors and six portable trench searchlights; and it is intended to conduct tests of emergency flares and other means of temporary lighting adapted to conditions of field service. Along with problems of lighting the field will be presented methods of signalling to and from aircraft at night, picking up aircraft by searchlight, methods of illuminating the aeroplane cockpit and its instruments, methods of recognizing the field by code signals, and a great many other experiments of similar character, of which information is at present either lacking or very meagre.

Still another problem is aviation clothing, which is also receiving serious consideration. Up to the present time the military service has not adopted a standard aviation uniform for flying. It is obvious that for work in extreme climes vastly different clothing will be required than that for service in the tropics. At the Mineola station experiments are being conducted to determine the best type of aviation clothing for winter flying. Correspondence with various firms on this subject has been going on for some time, and numerous different articles of clothing, from helmets to gloves, have been subjected to thorough test at the station. It is expected that by the close of the winter a definite equipment will have been determined upon as the result of these experiments. When it is borne in mind that the temperature falls at an approximate rate of three degrees for every 1,000 feet of ascent, the importance of warm clothing for aviators is immediately appreciated. Plans for heating the aeroplane cockpits have been considered, and it is not unlikely that experiments will be conducted along these lines in the future. But after all, it is the individual himself who should be kept warm by some means that is not subject to the functioning of the engine; hence warm clothing is a prerequisite.

As for the future, it is expected that with the establishment of aviation training stations in the summer of 1917 at points which are now under consideration, but which have not been definitely decided upon, an opportunity will be afforded for the training of a limited number of college men, either recent graduates or men in their senior year at school, who are interested in preparedness from the aviation standpoint. With the approach of universal military service, it is expected that every man will wish to place himself in a position where his own initiative in powers of self-reliance can be called out. The air service is practically one of the few services remaining where the individual is not lost in the mass. It is to be confidently expected that when the opportunities thus open for aviation training are realized, a large number of college men will apply for this instruction. In fact, plans are already in progress to interest men in some of the leading colleges in this movement.

The work of standardizing the equipment and methods in use at an aviation training school is also under consideration. This is a work of great importance and involves a tremendous amount of detailed study, ranging from the decisions as to the best type of hangar floors to the most suitable kind of observation tower, emergency signal systems, etc. Standard methods of training will also be worked out, so that regardless of the location of the school, the aviation student commencing his training will be given the same kind and amount of instruction, if possible. Standard reports and standard forms for use in the training department and other branches of aviation are also receiving attention. The selection of aviation sites is another problem which must be attended to with great care. There are certain desirable qualities in every aviation field, which, to the uninitiated, are not appreciated, but which are immediately recognized by every aviator who has had experience in the handling of men. To select such fields with due regard to their location with relation to large centers of population, and also with regard to possible demands in time of war, is a problem of great importance.

So far we have only dealt with the work connected with the training of fliers. There remains another task, and a great one, the making of military aviators out of the fliers. When once the fliers are available a further course of instruction will have to be undertaken, and the present plans tentatively call for these features: Fighting in the air, bomb dropping, night flying, artillery observation, and scouting from the air. Only after he has mastered these branches of the art, and not before then, can an aviator be considered ready for service in time of war.

Late, true, but *never* too late, say the officers in charge of laying the foundation of a great American air fleet—and we agree with them.

Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to correspondents are printed from time to time and will be mailed on request.

(14197) K. J. C. asks: Being a constant reader of your SCIENTIFIC AMERICAN, would you kindly publish in your next issue how to drill holes in glass. A. K. K. C. is informed that his question is worthy of an answer, but he cannot have it unless he sends his full name and address. We do not answer unsigned questions. All questions are answered by mail with little delay, and a few answers are printed.

(14198) J. O. M. asks: 1. What mechanical toy auto horn or device will make the loudest noise with the least effort or power? 2. What kind of a diaphragm in use will give the strongest vibrations outside of glass? 3. Has there been any attempt to make a flexible glass and what success has been attained? A. 1. We regret that we cannot answer the question what toy horn will make the loudest noise with the least effort. 2. A thin sheet steel diaphragm will give the strongest vibrations. It would require to be very thin in order to vibrate as well as thin glass. 3. There have been attempts to make glass tough and flexible, but all these efforts have so far been failures. It does not seem possible to make a silica and potash mixture which shall be flexible. Still we would not affirm that anything is impossible.

(14199) H. R. D. says: The writer is a faithful adherent to the cause of the SCIENTIFIC AMERICAN and wishes to take advantage of your above styled department, and will ask you to withhold my name, only using the initials "H. R. D." in referring to the inquiry in your columns. We wish to know your opinion and reason for considering either the gas motor truck or the electric motor truck of about 1 to 2½ ton capacity the most indispensable and economical providing we had a recharging plant for the electric motor. Also, what is about the necessary care an electric motor truck requires? A. We must say that many more gasoline motor trucks are in use than electric trucks. The gasoline vehicle is free from the battery troubles which the electric vehicle sometimes has. It can go longer distances from home, since gasoline can be procured almost everywhere now. The electric vehicle is somewhat limited to the larger cities.

(14200) H. R. D. asks: In connection with yours of the 9th instant, we would like to presume upon the liberty of asking you one more question concerning electric trucks. We note you refer to trouble with the batteries, and we are interested to know what kind of trouble is most prevalent, or the kind you speak of. If you can surround this subject pretty well we would thank you very much, or if you have a fee for such service render statement to the writer in person and I shall remit promptly. A. We are not prepared to write out the merits or demerits of storage batteries, or the causes of weakness and deterioration. You will find these clearly described in Lyndon's Storage Battery Engineering, which we will send for $4. These come under the designation of buckling, sulphating, loss of active material, danger of breaking jars, etc. The time required for recharging is to be taken into the account as well. Still owners of electric trucks in cities where roads are good and not too hilly, seem well satisfied with them. This is a matter which we cannot decide for any one.

(14201) P. L. F. asks: Would a barrel filled with water and placed where the temperature was maintained at one or two degrees below freezing, freeze solid? 2. Why is it that a barrel filled with water and frozen solid, will not burst the barrel, when a piece of wood long enough to reach from the bottom to above the surface is placed in the water before it freezes? A. 1. The water in a barrel placed where the temperature is anything below freezing will freeze if given time to freeze. A longer time will be required in case the temperature is but a few degrees below freezing than if it is colder, but the result is the same. Water freezes wherever the temperature is below the freezing point of water. 2. A stick of wood is said to prevent the bursting of a barrel when the water in the barrel freezes, if it is placed upright in the water. The reason would seem to be that the water freezes first on the upper surface, and as the freezing proceeds the stick frozen in at the top is lifted by the expansion of the ice and forms a space below, a partial vacuum, so that the ice below has room to form and not burst the barrel.

(14202) R. W. J. asks: Will you kindly give me the benefit of your valuable opinion on the subject of lightning-rods. I own property in southern Alberta, Canada, which was struck by lightning last summer and am planning to provide the property with protection this spring, but am in doubt as to which sort of rod is considered most effective and safest, the kind that repels or the kind that attracts lightning. I will greatly appreciate your opinion on the matter. I am a reader of your publication and have always found its opinions most reliable and all matters discussed in its pages most fairly and broadly dealt with. Wishing you continued success for the coming year and thanking you in advance for this favor. A. We do not understand your classification of lightning rods as repelling or attracting lightning. A rod is intended to convey the charge of electricity to the ground and thus prevent the building from being set on fire or shattered. When an electrified cloud comes over a house, the house and the air above it becomes charged with the opposite kind of electricity from that which is in the cloud. If the tension becomes too great a flash results and the rod should take the electricity and carry it safely to the earth. We think well of cables made of twisted copper wire, of which we have seen very good samples. These well put up, will last longer than iron, otherwise, iron is just as good as copper, and costs less. The instructions given in Thompson's Elementary Lessons in Electricity, price $1.65, about lightning rods are very good.

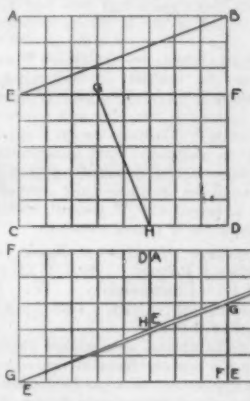
(14203) S. C. asks: With full appreciation of your kindness in answering other inquiries that we have sent you, we are writing to ask you if you can give us some information as to the power and range of the most powerful lights now in use anywhere in the world. We mean by this, such lights as are used in searchlights and light-houses. We presume that you can give us a little information on this subject, and thank you in advance for your kindness. A. The distance to which a light will be visible is determined in part by its intensity, but principally by its height above the sea level. A table may be found in Frye's "Civil Engineers' Pocket Book," on page 988 (price $5), which gives full data for all distances up to 66 miles, at which distance the curvature of the earth places the surface 2906.5 feet below the horizontal line, but refraction reduces this 406.9 feet, so that the apparent curvature is 2499.6 feet. A light must be 2499.6 feet above the surface of still water to be visible on the horizon at a distance of 66 miles. At 20 miles the corresponding elevation is 229.5 feet. The statement is usually made that a light house with a lamp 200 feet above the water can be seen at a distance of 20 miles in clear weather. This is a conservative statement. This subject is discussed very clearly in the "Encyclopedia Britannica," Vol. XVI, sub hoc verbo, especially on pages 645 et ff. with quite full tables of data for light-houses. The latest huge searchlight by Mr. Sperry gets its enormous rating by the use of mirrors which reflect a very strong beam in almost parallel lines. If this were raised high enough it could doubtless be seen more than 66 miles away.

(14204) G. D. asks: I would like to ask what action takes place in the composition of a "dry cell" when the amperage is run down. Is there any chemical change in the manganese dioxide and the ammonium chloride therein? Has the carbon electrode been affected any? In what proportions are these compounds mixed in making up a "dry cell." In a set of 4 dry cells showing 6 volts, 30 amperes, why do these cells after doing some work show no amperage and still have 6 volts. If the M^aO_2 has been changed to a higher or lower oxide or to a chloride, can it be changed back to its original form? A When a dry cell is exhausted its ammonium chloride has been changed to zinc chloride, its manganese dioxide has been changed to a lower oxide, to overcome to some extent the polarization; much of the zinc has been changed to zinc chloride, the carbon alone remaining unchanged. A dry cell can be treated like a storage cell and recharged to an extent, but it is a waste of good electricity to do it and costs much more than it comes to The best way is to follow the general practise and throw the old worn out cell away. A run down cell will show some voltage so long as any materials remain not used up, after the cell has become too exhausted to send any current. The voltage depends upon the materials alone. A cell made in a tiny cup will give the same voltage as if made in a hogshead, but it will not give the same amperes. The amperes depend upon other conditions upon the area of surface exposed to the chemical action and the weight of active material consumed in the chemical action. There are many formulas for making up the dry cells. They probably all employ a saturated solution of ammonium chloride in water. Chloride of zinc is usually an ingredient A full statement regarding these matters may be found in Pender's American Handbook, price $5.

(14205) W. B. McC. asks: We learn from the astronomers that the approximate distances of some of the nearer fixed stars from us are ascertained by means of their parallaxs; for instance, take the star Centauri, stated to be the nearest of all. An observer measures the position of a star at intervals of six months, and the resulting angular change of position is known as its parallax. The earth, in the six months, has traveled the semi-circumference of its orbit, whose diameter is about 186,000,000 miles. One half this distance and the parallax found by the two observations, are used to compute the distance of the star, said to be about four and one-third light-years, approximately twenty-five trillion miles. There is something your questioner cannot understand about this calculation and asks your explanation. If the sun was a fixed body at rest in absolute space the observer, six months after he took the first observation would be 186,000,000 miles distant from place of first observation, but these conditions do not exist. The sun itself, with earth and other planets, have a motion through space of about eleven miles a second. It is probable that our earth (also whole solar system) occupying now a certain position in space will never occupy same position again. The question is how is it possible to use the radius or diameter of the earth's orbit around sun as a base line for any calculation applicable to distances beyond solar system? A. The method

of finding the distances of the stars by their annual parallax has satisfied the best mathematical astronomers. There is no other method known. Young's Manual of Astronomy is his last work. In it he says, Sect. 547, "The distances of the stars are so enormous that the radius of the earth's orbit is too small for a convenient measure." As you say, light requires 4.3 years to come to us from the nearest star, we view that star and measure its change of position at intervals of six months, from positions about 93,000,000 miles on either side of the sun. In the interval the sun has traveled at the rate of eleven miles a second and taken the earth along with it nearly 174 million miles. But the star is twenty-five trillion miles away, which is about 145,000 times as far away from us as the sun had drawn the earth along during the half year. Surely the distance the sun has gone is too little to affect to a perceptible degree the accuracy of the annual parallax of the stars. The parallax of a Centauri is .75 seconds. If the sun were 176 million miles nearer to it, its parallax would only be changed in the order of hundred thousandths, too little to vitiate the result.

(14206) R. G. C. asks: Would like to have you explain this problem. A piece 8 inches square has 64 square inches. When cut and put together again, as indicated by my diagrams, it measures 5×13=65 square inches. This being a lumber camp exclusively, there is always a chance for an argument on square inches, but no one here can explain this one, so am taking this privilege of asking you. A. The trick to which our correspondent refers is one which should be immediately recognized as a trick. It is plain enough that no amount of ingenuity or special and secret knowledge will enable one to convert a surface of 64 square inches into one of 65 square inches, without stretching. One's attitude toward an alleged performance of this impossibility should be the same as toward the extraction of a family of rabbits and a large collection of assorted green groceries from the magician's silk hat; one should ask, not "how did he do it?" but rather "how did he make it look as though he had done it?" The solution of this particular puzzle is a well known one. We first saw it in the Boston Journal of Chemistry for March, 1887, and we have had it in this column several times since then. We last carried it in our issue of November 21st, 1908; and since it is doubtless now new to many of our readers, we give it again. The key to the mystery is that the rearranged square does not completely cover the rectangle, but leaves a narrow open space along the diagonal. The apparently perfect joint in reality gapes open. One is deceived because the pieces are seldom cut



with complete accuracy, and are usually of thin paper, which will not lie flat. When put together they seem to cover the rectangle well enough. A model of cardboard or thin wood will expose the fallacy. That the two edges of the long diagonal from G-E to B-H cannot match up will be plain from inspection of the square from which the pieces are cut. In this square, the line E-B has a slope of 3 in 8, or .375 in 1. The line G-H, on the other hand, has a slope of 2 in 5, or .4 in 1. Plainly these lines, when laid down upon parallel bases, will not lie in the same straight line. Our second figure shows the 5 x 13 "rectangle" as actually built up from the four pieces of the square. Lines E-G and B-E have slope 3/8; lines G-H and H-G have slope 2/5. Between these four lines we have a long, narrow parallelogram, which of course, turns out to be exactly one square inch in area.

NEW BOOKS, ETC.

THE JOY OF LOVE AND FRIENDSHIP. By Arthur L. Salmon. Chicago: Forbes and Company, 1916. 12mo.; 172 pp. Price, 75 cents, net.

Mr. Salmon discusses the essentials of true friendship, gives hints on the choosing of friends, warns us against expecting impossible returns, and shows us that we must exalt the ideas of work and service before we can possess exalted friendships. He takes up the relationships of children and parents, and of the man and woman, and his interpretations are everywhere sane and helpful without the taint of sentimentality.

ELEMENTARY MATHEMATICS FOR ENGINEERS. By Ernest H. Sprague, A.M. Inst. C. E. London: Scott, Greenwood & Son, 1916. 12mo.; 244 pp.; 101 diagrams. Price, $1.60 net.

The mathematical side of engineering and architecture is so bewildering in its vastness that the author's selective treatment of those parts which he has found by experience to be of the most practical use should prove valuable to the man of limited time. The text covers a wide field in a

small compass, brings out the essentials clearly, and illustrates principles by the introduction of useful material.

EDUCATION PHYSIQUE DES ADOLESCENTS. G. Demenÿ, Professeur du Cours d'Éducation Physique de la Ville de Paris. Paris: Félix Alcan. 8vo.; 157 pp.; illustrated. Price, 2 fr. 50.

M. Demenÿ is well known in France as an able writer on physical education; his present work is an introduction to body building and athletic training, with the emphasis placed upon suppleness and agility rather than upon abnormal muscular development and sluggish strength: in a final chapter the fundamental principles of physical education are applied to the needs of the industrial worker.

EXACT SCIENCE OF CHRISTIANITY. By L. Buckland W. Thompson, 1916. 8vo.; 157 pp.

If we take the words "science" and "Christianity" in their accepted meanings, then the title of this volume is doubly misleading, for its interpretations are as wide of the teachings of science as they are of the tenets of theology. By these interpretations the garden of Eden becomes the physical body, the solar plexus is made the dwelling-place of the Creator, the immaculate conception was merely a development of the subconscious mind, and we are urged alike towards psychotherapeutics and the annihilation of self; nor does the author seem to know that science invests the ether with substantiality and has certainly never regarded it as "the kingdom of spirit."

THE STORY OF THE FOREST. By John Gordon Dorrance, F. E., State Board of Forestry of Maryland. New York: American Book Company, 1916. 8vo.; 232 pp.; illustrated. Price, 56 cents, net.

Designed for use in schools, this book tells the story of our country's woodlands, and shows how well a knowledge of their meanings repays the ardent student. It narrates how the tree lives and dies, teaches the youthful reader how to know the commoner trees, takes him into the forest with the woodsmen, and gives him some idea of the wonderful by-products of the forest; concluding with the history of trees famous by reason of their connection with the activities of our ancestors. It urges the coöperation of the public in preventing forest fires and, without an uninteresting page, instills into the reader a love of the subject he is studying.

A LABORATORY MANUAL OF SOIL BACTERIOLOGY. By Edwin B. Fred, Ph.D. Philadelphia: W. B. Saunders Company, 1916. 12mo.; 170 pp.; illustrated. Price, $1.25 net.

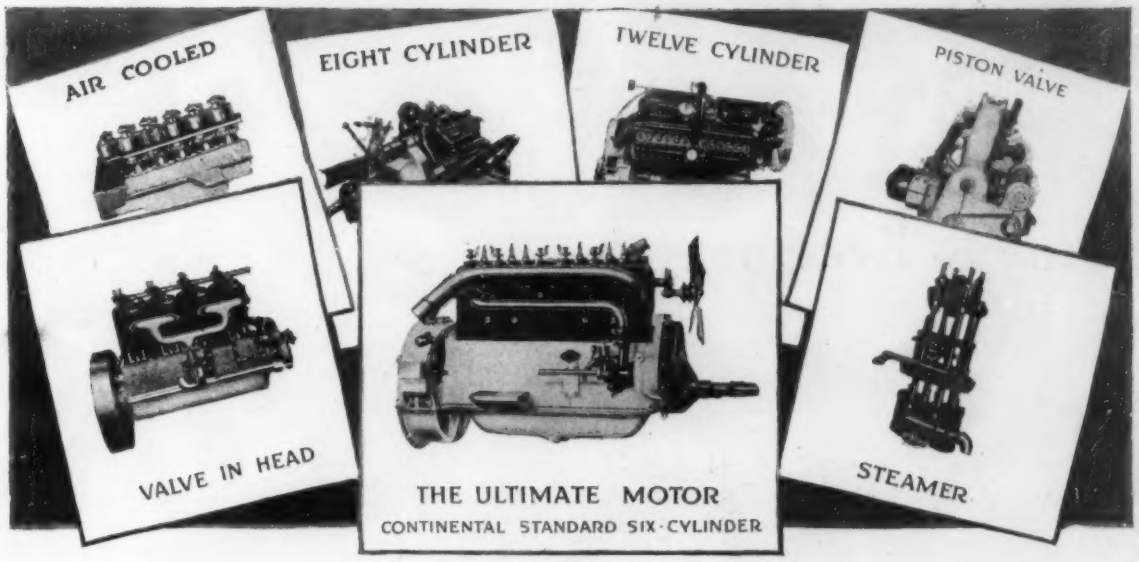
Students of soil bacteriology, soil chemistry and physics, and plant pathology will find this an exceedingly useful guide in the prosecution of their experimental work. It lists the necessary apparatus, tabulates the more important books and journals on the subject of bacteriology, presents exercises that have the object of quantitative results, and gives formulae and methods for the preparation of culture media, stains, and reagents, with qualitative and quantitative processes of analyses. The chemical methods of the standard text-books are those most generally employed, and a knowledge of general bacteriology and chemistry is of course assumed.

PERSONAL HEALTH. A Doctor Book for Discriminating People. By William Brady, M.D. Philadelphia: W. B. Saunders Company, 1916. 12mo.; 407 pp. Price, $1.50 net.

Dr. Brady's little medical sermons are always readable; he has a homely force in expression, and a facility in dry humor, that can be depended upon to tide the casual reader over places that might otherwise be hard and stony. Many of his ideas are radical, occasionally running to extremes; for example, probably few people will agree with him that a draught has nothing whatever to do with a cold. But on the whole his work is essentially sensible and practically helpful, and is further to be commended in that its strongest appeal is to the everyday individual who is most in need of health instruction, and who would be left unmoved by a more ponderous handling of the complex but highly important subject of physical well-being. Food, clothing, and common habits and ailments are fairly thoroughly discussed, and drugs play a very minor part in the author's Samaritanism.

AN INTRODUCTION TO ASTRONOMY. By Forest Ray Moulton, Ph.D. New York: The Macmillan Company, 1916. 8vo.; 599 pp.; illustrated. Price, $2.25.

The new edition of this favorably known work by the author of "An Introduction to Celestial Mechanics," has provided opportunity for rearrangement and the introduction of new material, practically amounting to a complete rewriting of the work. It is addressed to all those who are sufficiently interested in the universe to demand reasons for stated conclusions, and the selection and presentation of material holds this class strictly in view, and does not attempt to adapt itself to the more technical needs of the astronomer in the making. The author carefully leads up to the coördinate systems, so that by the time they are reached the knowledge of the reader is sufficient to surmount their difficulties. The introductory chapters deal with the earth and its motions and illustrate the careful methods by which scientific theories are established; these are followed by a study of the solar system, leaving the sun to the last because it necessarily introduces new and difficult considerations. Star maps and drawings elucidate the text, and there are problems that thoroughly test the student's knowledge of principles. It is an excellentaid to the intelligent appreciation of astronomical facts.



Motors vary in number of cylinders, in design, in construction. But there is only one that is recognized as standard—the Continental.

Several hundred manufacturers of motor vehicles in the United States compete actively for the favor of the buying public. Many of them build their own motors, each with entire confidence that his motor is superior to the others. But more than 150 manufacturers of automobiles and motor trucks agree that among all present day motors, the Continental stands foremost. They express their conviction in the most sincere way: by using the Continental Motor in their product.

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OFFICES: Detroit, Michigan
FACTORIES: Detroit—Muskegon

Largest exclusive motor manufacturers in the world

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What is it that makes GMC Trucks superior? What accounts for their *greater pulling ability*—the *consistent, dependable service* they give—the *low operating cost*—the *low upkeep?*

IT'S their practical, common-sense construction, their simplicity, their correct design—every unit built with a factor of safety, and easily accessible.

That's it. It's the way GMC Trucks are built that makes them superior—from the standpoint of owner and driver.

Because of their simplicity and accessibility, GMC Trucks can be readily cared for by the average driver. Maintenance cost is unusually low—repairs and replacements practically negligible.

You can buy GMC Trucks knowing confidently that they are fitted for the work—knowing that they will withstand the hardest kind of use—more than that, you have the assurance that with reasonable care they will render dependable service and operate profitably.

For the performance of thousands of GMC Trucks in hundreds of various lines of business in all parts of the country stands as visible evidence of what GMC Trucks can do.

Records of their performance in a business similar to yours, enable you to determine accurately what they will do for *your* business.

The GMC Line is Complete

There are GMC Trucks of the proper size and type to meet the requirements of any business—six sizes in all—¾ to 5-ton capacity—chain and worm drive.

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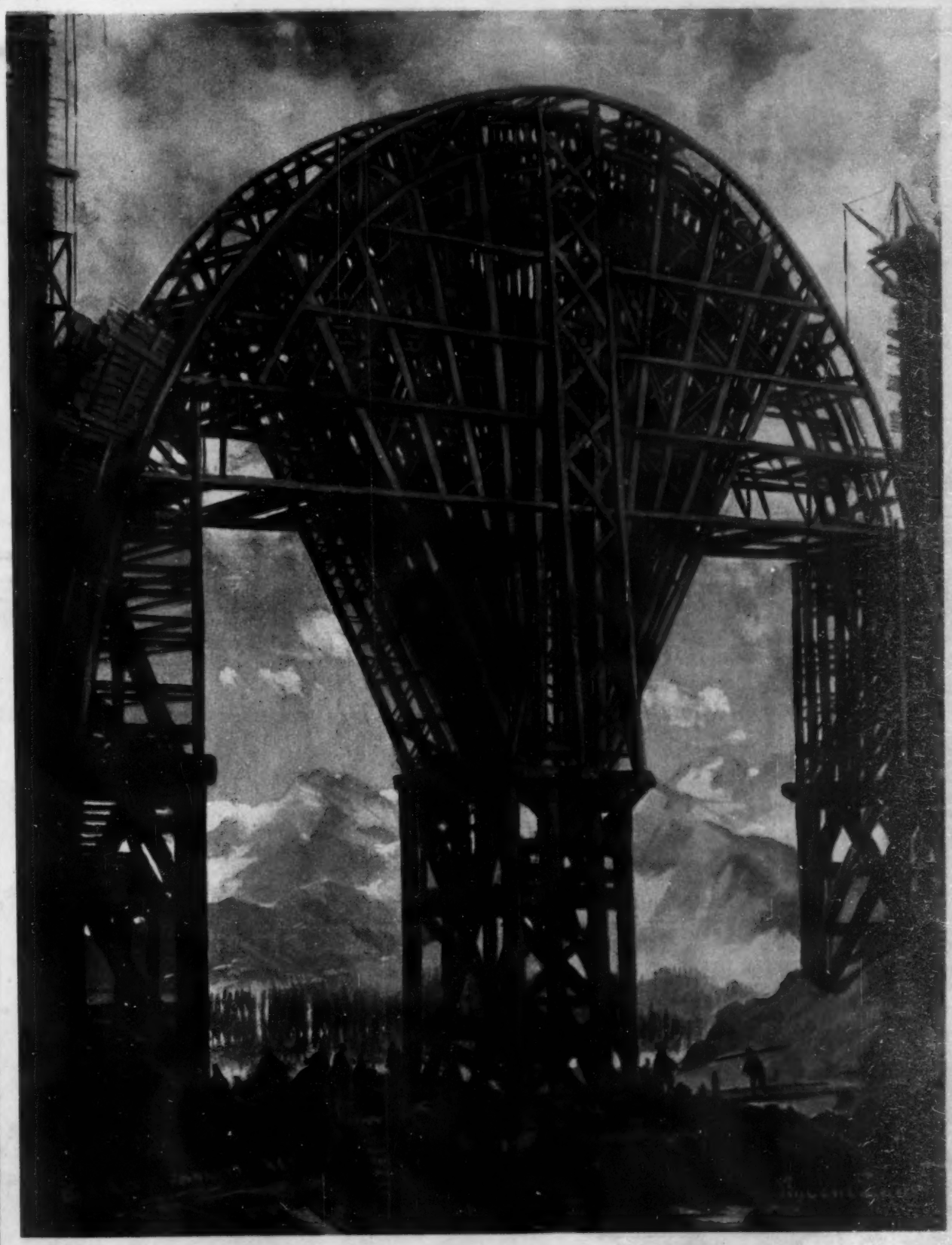

CONSTRUCTING A HUGE CONCRETE ARCH IN SWITZERLAND—[See page 205]

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